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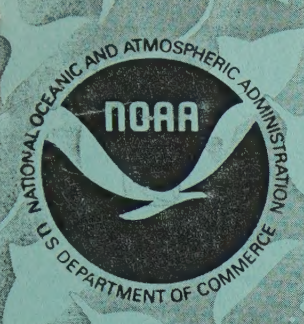

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STUDIES OF MARINE MAMMALS AT THE FARALLON ISLANDS 1982 - 1983

By

HARRIET R. HUBER, CLAIRE BECKHAM,
JACK NISBET, ANE ROVETTA, AND JERRY NUSBAUM

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JANUARY 1985

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Administrative Report LJ-85-01C

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ABSTRACT

Observations of pinnipeds and cetaceans on or near the South Farallon Islands are reported for the fourteenth consecutive year: six years under contract to the Marine Mammal Commission and five years under contract to the National Marine Fisheries Service. Five species of pinnipeds and five species of cetaceans were censused and observed from 1 September 1982 to 30 August 1983. This report also covers the winter 1983-1984 elephant seal breeding season.

During 1983 marine mammals along the California coast experienced an extreme change in their habitat: anomalously warm water, indicative of a lack of upwelling and a consequent lack of marine mammal food resources. Presumably because of these habitat changes we observed differences in many of the Farallon marine mammals. Fewer gray whales were seen during migration and during the summer. Humpback whales were seen later in the summer than usual. Blue whales were seen less frequently than in 1982.

The number of northern sea lion females present during the breeding season and the number of full term pups born was lower than we have recorded before. Premature pupping increased to 70%. Only three out of ten pups born were full-term and only one of these survived more than a few days. All seven premature fetuses were collected and analyzed. Leptospirosis was found in one specimen and an influenza-like virus in five others.

California sea lion numbers increased by 61% to 5570 animals. There was a three-fold increase in immature animals and many dead immature animals were found with empty stomachs. The first premature California sea lion pup on the Farallones was born in May. Two full-term pups were born but only one survived. Northern fur seals were seen less frequently than in previous years. Harbor seal haul out numbers increased; no pups were born on the Farallones.

The number of elephant seal pups born in 1983 increased by 29% to 475. Despite severe storms pup mortality remained at 32%. The average age of breeding females is now 6.3 years. Thirty pups died after weaning, most (26) on three calm, hot days in April. In 1984, elephant seal pup production was down 6%. The return rate of known females was significantly lower than in 1983. The rate of increase for males was down to 5% and the resighting rate of immature animals was down to 6%. These changes in 1984 are probably more the result of El Nino than any permanent changes in the Farallon Mirounga population.

The survival rate in Farallon-born immatures between 1980-1982 is less than half (16.6%) the survival rate in immatures born between 1975-1978 (37%). This decline in the population not apparent from looking at pup production. Emigration of immatures now is slightly lower than in 1975-78. An immature male was resighted on Isla San Martin in Baja, Mexico, extending the southward range of Farallon-borns by 350 km. Seven elephant seal stomachs were salvaged; two were empty, the others contained 8 species of squid.

INTRODUCTION

Many reports describing the wildlife of the Farallon Islands, California, have appeared since 1854 (see review by Ainley and Lewis 1974; Ainley et al. 1977a), and most have briefly mentioned marine mammals. The first real census work on Farallon pinnipeds was done by Bonnot and is summarized in Bonnot et al. (1938).

Three pinniped species (northern elephant seal, harbor seal, California sea lion) have recently established, or seem to be in the process of establishing, breeding populations at the Farallones. A fourth species (northern fur seal) which probably was a former breeding species is increasing the frequency of its visits. This provides a unique opportunity to study comparative colonization processes by pinnipeds. A fifth species (northern sea lion) has declined in number, yielding another opportunity to learn about changes in wild populations. Since biologists from the Point Reyes Bird Observatory (PRBO) are present year round on this remote natural laboratory, these opportunities are not being ignored. PRBO looks forward to maintaining a station on Southeast Farallon indefinitely, thus insuring collection of long-term data sorely needed to understand short- and long-term fluctuations in marine mammal populations. Results of studies from 1971 to 1982 are reported in Ainley et al. (1977a, 1977b, 1978) and Huber et al. (1979, 1980, 1981, 1982, 1983). This report covers information collected from September 1982 to August 1983 and the 1984 elephant seal winter breeding season. Support for these studies came from the Marine Mammal Commission (1974-1980) and National Marine Fisheries Service (1978-1983).

THE FARALLON ISLANDS

Southeast Farallon and West End, shown in Figure 1, compose the South Farallon Islands or South Farallones which, with several other close-by large rocks, comprise about 44 hectares (100 acres). The North Farallones, three large rocks, lie 8 km to the north. The South Farallones are 43 km west of San Francisco, California, and 32 km from the closest land, Point Reyes directly north and Bolinas Point to the northeast. The islands are on the brink of the continental slope with deep oceanic waters lying immediately westward and shallow inshore waters lying eastward. The islands are positioned at the eastward edge of the cold, productive waters of the California Current.

Few other places in the eastern North Pacific provide habitat for the number and variety of wildlife that occur at the Farallones: eleven breeding species of seabirds with a combined population of over 250,000 constitute the largest seabird breeding colony in the contiguous United States; more than 325 species of birds have visited the islands; and five species of pinnipeds haul out there, at least four, and perhaps all, of which have bred on the islands. Sea otters also are said to have bred at the Farallones.

During the 1800's and through the early 1900's the Farallones were subjected to much disturbance by humans. Sealers exterminated fur seals,

elephant seals, and sea otters and hunted sea lions for food (Scammon 1874; Riddell 1955; Doughty 1971). In 1854 a lighthouse was established and has been maintained continuously since. For most of that period at least four families, with their associated pets and mules, lived on the South Farallones year round. In 1854 a commercial egg company began an unregulated harvest of seabird eggs that continued until the early 1900's with apparently little regard for other wildlife. During recent years the presence of the U.S. Coast Guard has deterred visitors. The Farallones, with the exception of the South Farallones, have been a Federal Wildlife Refuge since 1900. In 1969 the South Farallones were included. Because of the islands' relative remoteness, not much active protection had been practiced until PRBO personnel set up a station in April 1968. When the Coast Guard automated its equipment in 1972, PRBO entered into a cooperative agreement with the U.S. Fish and Wildlife Service under which PRBO conducts research, helps coordinate the activities of other researchers, protects island wildlife from human disturbance, and helps maintain the island's facilities. The marine bird and mammal populations have responded dramatically to the gradually lessening disturbance over the past decade (Ainley and Lewis 1974; PRBO unpubl.).

METHODS

With the exception of elephant seal censuses, little attention was paid the pinnipeds during the first few years of PRBO occupation. In 1971 and 1972, occasional counts of sea lions were made and in mid-1973 regular censuses were started. From June 1974 through August 1980, censuses were conducted under contract to the Marine Mammal Commission. Since September 1978 censuses have also been carried out under contract to the National Marine Fisheries Service.

Elephant seals have been counted regularly from blinds or from other points near their preferred haul our areas since 1970, daily during the breeding season and at least once a week during the rest of the year. Beginning in 1976, elephant seals were counted twice-weekly during spring molt and fall haul out when the greatest number of animals is present. During the seabird breeding season (from the end of May to 1 August) we counted the elephant seals from Lighthouse Hill (elevation 109 m) to minimize disturbance to both birds and seals. This census point lowers counts slightly, as portions of the seals' usual hauling out spots are not visible from Lighthouse Hill. However, few seals are present during most of that period and we consider the error relatively insignificant. Whenever possible the tag numbers of animals tagged on the Farallones and other islands were read with binoculars and recorded. Untagged animals were often recognized by individual characteristics (scars, etc.), a record of which is kept on file.

The number of harbor seals hauled out varies greatly from one day to another. Whenever observed, their numbers have been recorded; since 1973 a conscious effort has been made to find them. Beginning in 1976, they were

included in weekly censuses which are conducted at low tide in order to get maximum counts.

Censuses of sea lions were made between 1400 and 1600 hours. Twelve all-day watches in which sea lions were counted revealed that maximum numbers hauled out during these hours. Weekly counts were made from Lighthouse Hill and other vantage points using a 25x spotting scope. These counts included animals in the water. Since California sea lions tagged on the Channel Islands began showing up in 1982, an effort to read tags consistently has been made.

Northern fur seals were recorded whenever observed.

Beginning in the fall of 1970, cetaceans were recorded when sighted. During the course of other activities, the ocean to the south and west of the island was watched intermittently for at least 2 hours daily, weather permitting. Cetacean sightings made by different observers (with binoculars and/or 25x spotting scopes) were totaled at the end of the day and duplicate sightings eliminated.

SPECIES ACCOUNTS

California gray whale (Eschrichtius robustus)

Gray whales were seen every month between September 1982 and August 1983. The first southward bound whales were seen in mid-December; the southern migration continued through the month of January. The northern migration lasted from mid-February until the end of March. The dates of both migrations are similar to previous years but fewer animals were seen (Table 1). This may be due to the severe winter storms with accompanying large swells which obscured visibility.

In most other years up to 5 individuals (recognized by distinctive barnacle patterns) have remained near the island for up to 2 months during the summer, presumably feeding near the island. In 1983, a year of high water temperatures and low ocean productivity (as indicated by near failure of the Farallon breeding birds), there was only one sighting per month of a gray whale remaining near the island during the summer (Table 1). Where they went is a mystery, but it is clear they were not within sight of the island.

Humpback whale (Megaptera novaeangliae)

The pattern of humpback whale sightings was different in 1983 as well. There was a single sighting in the spring of 2 individuals at the end of May and no other sightings until early July when humpbacks were seen almost daily until the end of August. High count was 10 on 22 August (Table 2). Since 1977 the pattern has been spring sightings April through June and fall sightings from late August until late November. This difference may

also be related to the high water temperature.

Blue whale (Balaenoptera musculus)

Blue whale observations, however, were similar to recent years, with sighting of 2 to 3 whales in September and October 1982, and 1 to 2 blues in July and August 1983 (Table 3). Blue whales were first seen from the South Farallones in fall 1981 (Huber et al. 1983).

Other cetaceans

Other cetaceans seen were 15 Dall's porpoise in June and 2 fin whales at the end of July (Table 4). There were 25 unidentified whale sightings between 3 September 1982 and 19 August 1983.

Northern (Steller) sea lion (Eumetopias jubata)

The northern (Steller) sea lion censuses during 1982-83 fluctuated as they have in recent years with peak numbers occurring during the breeding season (Figure 2). High count was 141 animals on 2 June (Table 5). Ten pups were born; seven of these were premature (born between 7 April and 10 May). Only one of the three full term pups (born after the third week in May) survived more than a few days, bringing pup mortality to 90%--the highest recorded on the Farallones (Table 6). All seven premature fetuses were collected and analyzed for disease pathogens by researchers from Oregon State University. Evidence of the bacterium Leptispirosis was found in one fetus and an influenza-like virus in 5 others. No evidence of the calici virus SMSV was found. Leptospirosis and SMSV have been found in conjunction with premature pupping in California sea lions. Fetuses will also be analyzed for the presence of organochlorine residues by Bodega Bay Institute. All but one of the fetuses was alive at birth.

Female and immature northern sea lions are present on the Farallones throughout the year, while adult and subadult males migrate into the area only during the breeding season (Table 5). In 1983, subadult males were seen during winter censuses; adult males first arrived in early May and remained until late July. Subadult males remained until mid-August. The number of males seen remained high with up to 13 adults and 12 subadult males present, although only 6 bulls held territories. One bull was seen on both Pt. Reyes headlands and the Farallones in June. The number of females present was lower than in any previous year and the number of full term pups born lower than we have recorded before (Table 6). Whether this is a result of the warm, unproductive waters of El Nino or if it is the continuation of a steady decline in the northern sea lion population on the Farallones remains to be seen. Large numbers of pups and yearlings migrated to the Farallones in late fall as has occurred for the past 5 years. In contrast to other years they remained on the Farallones through February. Ninety-two animals (no pups) were censused on North Farallones during breeding season.

One female northern sea lion was seen on West End in spring, the first occurrence of a northern sea lion on West End in recent times, although photographs taken in the 1930's show large members of northern sea lions at Indianhead on West End.

California sea lion (Zalophus californianus)

The numbers of Zalophus on the Farallones continued to climb during 1982-1983 (Figure 3). The peak count was 5570 on 28 July (Table 7). This is a 61% increase over the previous peak in September 1982. Although the Farallon population has increased each year since 1977, never has the rate of increase been so great. There were several other unusual occurrances in the Farallon Zalophus population which may be related to these unprecedented numbers: the percent of immatures (1-3 year olds) present increased three fold; 33 dead immature Zalophus were observed between January and August 1983 (the previous maximum was 8). We examined 10 of the 33 stomachs: nine were empty and one contained the lower beak of Octopus rubescens. The abnormally warm water temperature off the California coast in 1983 may have induced immature Zalophus to move northward in search of food causing the increased proportion of young Zalophus around the Farallones; insufficient food resources there may be responsible for high numbers of dead immatures with empty stomachs.

Other differences between 1983 and other years include an increase in the proportion of immature females present. Based on inspection of 40 animals in fall 1983, 30% were females. Inspection in previous years revealed 100% males.

On 6 May 1983 a premature pup was born--the first premature California sea lion on the Farallones. Like the premature northern sea lion pups it was alive at birth but died within 24 hours; it appeared fully furred. Three weeks later, on 27 May, a full-term pup was born and a second was born on 9 June. The first pup was not seen after the first week; the second was seen through August.

At least 59 animals tagged as pups on the Channel Islands were re-sighted on the Farallones (Heath, Francis, Oliver). Four young males released by the Marine Mammal Rehabilitation Center were seen on the Farallones up to a month after release.

Northern fur seal (Callorhinus ursinus)

As has become usual the last few years, northern fur seals, up to 3 at one time, were seen on the Farallones September through mid-November. Those that it was possible to sex were all young males. Generally a few fur seals are seen sporadically in the winter but in 1982-83 none were seen again until mid-April. A recognizable adult male, which first showed up at the Farallones as a subadult and has been seen every summer since

1978, arrived at the end of May and remained until July. For a week in June he was accompanied by a female-size animal of unknown sex.

Most northern fur seals breed on islands in the Bering Sea, but there is also a small breeding colony on San Miguel in the Channel Islands. Both tagged fur seals that have been seen on the Farallones came from this southern colony (Huber et al. 1981).

Harbor seal (Phoca vitulina)

The number of harbor seals seen each year continues to increase (Figure 4). The high count in 1983 was 90 animals (Table 8). More than 50 animals were seen in all months except September and February. Despite the increased numbers of adults and subadults, the probability of breeding and pupping occurring on the Farallones seems unlikely. For the last three years pups were not observed until July and it is probable they were born elsewhere.

Northern elephant seal (Mirounga angustirostris)

Northern elephant seals are recovering from near-extinction by sealers during the 1800's. The population dipped to less than 100 animals around the turn of the century and is now estimated at 70,000. The first re-colonizer was seen on the Farallones in 1959: breeding began 13 years later. With the growth of the colony, seasonal peaks have changed. In the early years, the yearly peak occurred in the fall during the haul out of immatures, by 1974 the spring peak of molting adult females and immatures was equal to the fall peak and by 1982 the spring peak was almost double the fall peak (Figure 5). Now the breeding population has grown so that the winter peak is equal to the spring peak (Figure 6, Table 9).

Breeding season 1983

As we've come to expect, the number of elephant seals present during the breeding season increased again in 1983: 194 males were present (Table 10), an increase of 19%, and 487 females were present, an increase of 30% (Table 11). There were 475 pups born, an increase of 29% (Table 11). We tagged 555 individuals, primarily pups (Table 12). The chronology of the breeding season was similar to previous years (Table 13). The average age of females has risen to 6.3 years (Table 14) and to 5.7 for Farallon-born females (Table 15). The age structure of the males on the island has changed slightly in the last few years: one third of the males are now over 7 years of age (Table 10). The majority of breeding animals are still immigrants--only 22% are Farallon born (Table 16). New pupping areas in 1983 included Boiler Cove, Sea Pigeon Gulch and Marine Terrace West; however, only Marine Terrace West has much future as a pupping area, the others are awash during high tides and mortality there was 100%. There were more winter storms in 1983 and they were fiercer than experienced before.

In a "normal" year most of the beaches used by elephant seals are above the effects of the tide and storms, but the intensity of the 1983 storms reached even the major pupping area of the Sand Flat which was awash during several storms. Pup mortality on the Sand Flat increased from 20% in 1982 (Huber et al. 1983) to 33% in 1983 (Table 17).

The storms, as expected, washed away many pups but because they did not occur until late in the season, some pups were old enough to follow females to higher ground. During the storm of Jan 24-27, 20 cows moved from other beaches to the high ground of the Sand Flat, half with their pups (age 10 to 24 days). The storms, by removing sand from one beach, then depositing it on another, and undermining or filling in former caves, permanently changed the character of many beaches on the Farallones.

Despite the severe storms pup mortality on the Farallones was 32%, similar to 1982 (Table 17). On other islands--San Miguel and Ano Nuevo--characterized by large open beaches exposed to the ocean, pup mortality was higher than ever before (Stewart, Le Boeuf pers. comm.).

Breeding season 1984

For the first time since breeding began in 1972, the number of females present on the Farallones decreased over the previous year (Table 11). In 1984 pup production was down 6% to 447 (Table 11) pups and the rate of increase in the number of males present (205) was only 5% (Table 10). These differences are probably more the result of the Pacific Ocean warm water anomaly of 1983--"El Nino"--than any permanent changes in the population dynamics of the Farallon Mirounga population. The chronology of the breeding season was similar to previous years (Table 13), although males arrived later and left earlier than in 1983.

The oceanic changes associated with El Nino, so apparent in 1983, continued into the winter of 1983-84 including high water temperatures and a virtually stormless winter. Generally, when female elephant seals arrive on the Farallones, they haul out first on small sandy beaches and then, presumably because waves and winter storms keep the beaches awash, move to the main pupping area--the high, rocky Sand Flat. In 1984, many females which had pupped successfully on the Sand Flat in the past, remained on peripheral beaches because of the mild weather conditions. The number of females pupping on these peripheral beaches more than doubled from 38 in 1983 to 87 in 1984.

Overall pup mortality was 33%, similar to 1983, but with an increase in number of pups washed away and an increase in the number of stillbirths (Table 17). A comparison of pup mortality on selected beaches appears in Table 18. The peripheral beaches MB, NL, GG and MV are characterized by a sandy substrate, exposed to the effects of high tides and swells. On these beaches during the stormy 1983 season, 8% of all pups were born and mortality ranged from 54 to 100%. During the mild season of 1984 20% of

all pups were born in these same areas and mortality decreased (22 to 82%). It appears that females prefer these sandy beaches and will choose them over high rocky beaches even if they have raised pups successfully on the rocky beaches in the past.

Another weather-related difference between the two kinds of pupping areas was a series of calm, hot days in 1984 which put heat stress on the animals on high rocky beaches while leaving seals on lower, cooler beaches unaffected. Under heat stress cows and pups can become permanently separated, leading to increased pup mortality.

This heat stress also affected males: on the Sand Flat, the dominant male abandoned the beach and went into the water at mid-day, presumably to cool off, then returned between 1 and 5 p.m every day for a two-week period. The effect on his copulation record was not as great as it might have been since most of the other males also went into the water or appeared too stressed by the heat to take advantage of the dominant male's absence. The dominant male in 1984 accomplished 25% (Table 19) of copulations observed compared with 21% of copulations in 1983 (Table 20). In 1983 only 16 males completed more than 5 copulations; in 1984, 22 males completed 5 or more copulations. The time of peak copulations, 13 to 19 February, was later than previous years. Eighty-eight percent (112/126) of the females present were observed to copulate.

Figure 7 shows the changes in the age composition of males through the breeding season on a major pupping area. The youngest males are gone from the entire island as well as the breeding areas by mid-January (Figure 8). The biggest change in the breeding area occurred around 9 January, the day before the first copulation: the total number of males present decreased by more than half--most of these SA1 and SA2 (4 to five year olds). Although some of these younger males left the island completely, most just moved from the breeding areas to peripheral areas (Figure 8) and returned to the breeding areas during peak copulation time in late February.

The Effects of El Nino

Because the warm waters of El Nino had such a devastating effect on the Farallon bird breeding population, spring breeding pinnipeds on the Channel Islands, and seemed to affect strongly the haul-out patterns of non-breeding Zalophus on the Farallones, we wondered if and how the Farallon elephant seal population would be affected. Since elephant seals are winter breeders and also fast during their breeding season, they were not really affected by reduced food resources during the winter of 1983. However food availability did affect the young of the year and adult animals already stressed by fasting. We attribute the reduced breeding population in 1984 to the effects of El Nino. The total number of pregnant females was down 6% over 1983 and we found the return rate of known breeding females was significantly lower between the 1983 and the 1984

breeding seasons than between the 1982 and 1983 breeding seasons (2 x 2 test, $p<.02$). There was also a significantly higher percent of females present during the 1984 spring molt which did not breed the previous winter than in 1983 ($p<.05$). Normally in any given year about 10% of known females do not pup; in 1984 at least twice that many did not pup. Females arrived, on the average, two days later but this difference was not significant. The return rate in the fall of pups born in 1983 was significantly lower than ever before (6%), half of the return rate for pups born in 1982.

The effects on males were not so obvious. Return rates for all age classes of males except SA3 (6 to 7 year olds) were lower in 1984 than in 1983 as was the overall return rate: 47.4% in 1984, 50.9% in 1983. In comparing the arrival and departure dates and total amount of time on the island for tagged bulls present in both years, we found, on the average, that bulls arrived 2 days later, left 2 days earlier, and spent 5 days less time on the island in 1984 than in 1983. Although these differences were not significant, the growth rate of the male population between 1983 and 1984 was significantly lower than in previous years.

That the effects of El Nino on the female elephant seals is stronger than on the males, can be explained by the increased stress on females which must supply food not only for themselves but also for a growing fetus and later on a nursing pup. It is also possible that males and females feed on different prey.

Another difference in female behavior was the overall attendance pattern of females on the Farallones. Figures 9, 10, and 11, show a comparison of female attendance on different beaches between the 1983 and 1984 breeding seasons. On the two major beaches, Sand Flat and Shell Beach, the total number of females present was lower and they departed earlier than in 1983. At Indian Head, the arrivals, peak, and departures, were all shifted 3 days later in 1984 than in 1983. The pattern island wide, is shown in Figure 12. Arrival and departure dates are similar but the peak was lower and almost a week later in 1984 than in 1983.

Pup mortality

From 1972 to 1983 the number of pups born on the Farallones has increased each year. The overall pup mortality during that time has fluctuated between 6 and 71%. In general, pup mortality on the Farallones increased in the early years, then leveled off at 41% and now has begun to decrease (Table 18). From 1975 to 1980 density (number of females present) and the rate of pup mortality correlated closely ($y = 0.0669 + 0.0013x$ $r = 0.8786$ $p<.05$), but in 1981, density increased while mortality remained constant. Since then density has continued to increase by about 26% each year (until 1984) but the mortality rate remains lower than in 1980 and 1981. From 1981 to 1983 the correlation between density and pup mortality is unclear ($y = 0.4395 - 0.0002x$ $r = 0.3962$ $p>.05$). However, if the average age of females pupping on the Farallones is correlated with

pup mortality for the years 1980 to 1983, the mortality rate decreases as age increases ($y = 19.1514 - 3.5595x$ $r = -0.9851$ $p<.05$). This may help to explain the higher rate of pup mortality on the Farallones than on San Miguel and Ano Nuevo. Although the mortality rate on the Farallones even now is higher than at established colonies, we can expect that as the proportion of older and more experienced cows continues to increase the pup mortality rate will decrease to the level of Ano Nuevo (13-25%) or San Miguel (4-8%).

Weaner mortality

Between 1976 and 1982, a small percentage of pups died after weaning but before leaving the island in the spring (Table 21). Thirty pups died after weaning in 1983 (9% of those that survived to weaning). Four died within a few weeks after weaning, crushed by adult and subadult males, which has been the major cause of death in the past. What was unusual in 1983 was that twenty-six pups died during a three day period of high temperatures and calm weather (5-7 April). All live animals had gone into the water, presumably to cool off. The dead pups ranged in age from 65 to 92 days; there were 10 males, 16 females. Weights and measurements were taken of the 12 animals in the best condition (7 females, 5 males). On the average males were 10 pounds heavier and 5 cm longer than females. We were unable to find any cause of death in the 12 animals we necropsied but speculate that it may be related to heat stress or to some disease exacerbated by heat. Rectal and nasal swabs taken from a few animals revealed no disease pathogens and at present the cause of this die off remains unknown.

Adult mortality

In 1983, two breeding females died on the Farallones on 4 and 26 February. We necropsied, weighed, measured and examined uteruses of both females. Necropsy revealed neck and chest bruises and extensive internal hemorrhaging. It is presumed they died during attempted copulation. Low follicular development in both females indicated that neither cow was in estrus. One female was 9 feet and weighted 602 lbs, the other was 9.5 feet and weighed 726 lbs. Neither animal was tagged before so we have no previous history on them. One female had a uterine scar indicative of one previous pregnancy. One other breeding female has died on Farallones under similar conditions (Huber et al. 1981).

In 1984, two subadult males died on the Farallones, the first on 28 January 1984, the second on 27 February 1984. The second one was observed crushed by a bull chasing a female and died a few minutes later. The first was found at the end of a calm, hot day, 1/4 mile from the ocean. It was swollen and bloated, although less than 24 hours dead. No cause of death was found, but we suspect heat stress. Measurements were impossible because of severe bloating. That animal weighed about 1,500 lbs. Stomach contents were taken from all four animals (see food habits section).

Immatures

Fall haul out Elephant seals haul out 3 times during the year; winter breeding season, spring molt, and fall haul out. The fall haul out, which is primarily composed of immature animals, is the least understood of these. There is no known physiological reason for immatures to be on land during this season and speculation on the purpose of this haul out includes resting time, socialization, and learning prospective breeding areas. Interactions between animals are minimal and mainly involve jousting bouts between immature males.

Since we began tagging pups in 1972, we have identified surviving animals by reading tags in the spring and fall. It is only in recent years, however, that our sample size of males and females in the various age classes has been large enough to try to determine patterns. The fall haul out begins in early August as the large males return to the ocean after their summer molt, and ends in early December when the adult males return to the island for the breeding season. The peak number of animals occurs in the first two weeks of October. In comparing the fall haul outs of 1982 and 1983, we found that yearlings and two-year-olds are present throughout the season beginning in August, three-year-olds arrive in September, and four-year-olds in October (Figure 13). Males and females are present throughout the fall in nearly equal numbers, although in 1982 more males stayed longer and in 1983 more females remained on the island longer (Figure 14). In 1982, 76 Farallon-born immatures were present, 32 females, 37 males, and 7 unknown sex. In 1983, there were 103 individuals, 46 females, 46 males and 11 unknown sex. None of these differences is significant.

Two interesting patterns emerge: males and females haul out in nearly equal numbers through age 3, but by age 4 only males haul out in fall. This can be explained by the fact that by age 4, 80% of females are breeding, and these haul out in winter. In 1982, as age increased, the number of animals hauled out decreased, but in 1983, the number of 2-year-olds exceeded the number of yearlings. This could be due to a strong 1982 age class or merely reflect the high, post-weaning mortality of the 1983 year/class. Other differences between the two years: 4-year-olds arrived nearly a month later in 1983 and yearlings spent less time on the island. All of these differences may be the result of difficulty in finding food during El Nino causing all age classes to spend more time at sea.

Population Dynamics As expected in a growing colony, the age structure will change over time. In the early years of the Farallon colony (1974-75), adults were only 13.9% of the population, but by 1983-84 the proportion of adults has increased to 52.7%. Despite the growth in adult numbers, the survival rates of immature animals has declined (Table 22). While the growth rate was high (Table 11), survival rate of Farallon-born animals was also high, but when the growth rate dropped below 30% (1980), survival rate

of immatures also decreased.

From 1975 to 1978, survival to the first year (corrected for tag loss) averaged 37.9%, from 1980 to 1982 it declined significantly to 16.6% ($t = 5.892$, $p<.01$). We feel this is a difference, not just in resighting but in actual survival, since tag resighting effort has remained the same or even increased and emigration has not increased (see below). It is interesting that this information describes a trend of decline which is not apparent from looking at pup production. It remains to be seen whether this applies to other California colonies, or is merely a reflection of elephant seals at the northern edge of their range.

Emigration Sightings of Farallon-born elephant seals on other islands have been recorded since 1975. In the beginning, up to 40% of tagged pups were seen on Ano Nuevo, San Miguel, or San Nicolas Islands, but in the last few years this has decreased to 30-35%. The number of females emigrating is markedly greater than the number of males but this difference is not significant ($x = 2.94$, $p<.10$). Many of these emigres return later to the Farallones to breed: only 12% of the females seen on other islands remain there to breed. With emigration occurring at the rate it does now, coupled with reduced survival of Farallon-born immatures, it is doubtful the Farallones will become a self-sustaining colony in the near future.

Tag returns

Since pupping began in 1972 all pups surviving to weaning on the Farallones have been tagged (except 1979). Resightings of these animals have occurred mainly on the Farallones although in the past animals tagged on the Farallones have been seen as far south as San Miguel Island off Santa Barbara and as far north as Cape Arago, off the Oregon coast and as far east as Martinez in San Francisco Bay. In January 1984, a yearling male was sighted on Isla Martin in Baja, extending the southward range of Farallon animals by 350 kms.

Minimum survival of Farallon-born animals 1974 to 1982 based on resightings can be found in Table 22. Animals double tagged as pups were checked for tag loss (Table 23) and survival rates were adjusted upward to account for tag loss which by the fourth spring almost doubled the survival rate (Table 24). Farallon-born animals are still only a very small part of the Farallon breeding population: 4.6% in 1983 and 4% in 1984. All growth of the Farallon population is still due to immigration.

Food habits

In 1983 and 1984, seven Mirounga stomachs were salvaged: two adult females, two subadult males and three immature males. The stomachs of one immature male and one subadult male were empty. The others contained 8 species of squid (Table 25). Since little is known of the feeding or dispersal habits of these squid species it is not possible to say whether

some of the smaller squid are actually elephant seal prey or just prey of larger species of squid. No otoliths were found although one stomach contained fish lice (Lironeca sp.) and unidentified fish teeth.

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Table 1. Number of gray whales seen from South Farallon Islands, 1982-83.

DATE 1982	Minimum Number	Direction of Travel N	Direction of Travel S	Remain Near Island
Sep 18	1			
20	1			
21	1			
22	2			
23	2			
24	1			
25	2			
27	1			
28	1			
30	3			
Oct 3	1			
4	1			
5	3			
6	1			
9	2			
10	1			
11	2			
13	1			
14	1			
15	1			
16	2			
17	2			2
18	2			
19	2			
21	1			
23	2			
24	2			
25	2			
26	2			
27	2			
28	1			
29	1			
30	1			
31	1			

DATE 1982	Minimum Number	Direction of Travel N	Direction of Travel S	Remain Near Island
Nov 1	1			
2	2			
3	1			
4	2			
5	1			
6	1			
8	1			
9	2			
12	1			
13	1			
16	1			
19	1			
20	1			
21	1			
23	1			
Dec 2	1			
5	1			
6	1			
7	1			
8	1			
9	2			
10	1			
11	1			
13	6		6	
14	1			
15	1			
18	1			
26	5			
28	3			
29	12			
30	8			
31	1			

Jan 1	5		3
2	6		1
3	6		2
4	16		13
6	2		1
8	1		
9	4		2
10	5		13
11	11		4
12	5		
13	18		12
14	8		5
15	2		2
16	12		12
17	16		15
19	7		6
20	8		8
22	1		1
23	3		
24	8		5
25	1		1
27	4		4
30	5		5
31	4		3
Feb 1	3		
3	4		4
4	5		
6	1		
10	1		
12	1	1	
14	7	7	
15	6		
17	2		
18	1	1	
19	4	4	
20	3	1	2
21	10	7	
22	1		
24	15	6	
26	1		
Mar 4	12		
5	3	1	
6	11	3	
7	3	2	
8	7	5	
9	3	1	
10	9	7	
11	3		
12	1		
13	1		
14	1		
15	2		
16	1		
17	2		
18	1	1	
19	2		
21	2	2	

Apr 1	1		
6	1		
8	2		
9	1		
13	1		
14	1		
17	1		
18	2		
19	1		
20	2		
25	1		
27	2		
28	1		
30	1		
May 1	1		
2	2		
4	2		
8	1		
19	1		
21	1		
28	1		
Jun 2	1		
7	1		1
10	1		
18	1		
24	1		
29	1		
30	1		
Jul 3	1		
4	2		
6	1		
7	1		
12	1		
17	1		
18	1		
19	1		
20	1		
22	1		
28	1		
Aug 1	1		
2	1		
4	1		
5	1		
10	1		
11	1		
13	1		
15	1		
18	1		
20	1		
21	1		
22	1		
23	1		
25	1		
26	2		
28	1		

Table 2. Sightings of humpback whales from South Farallon Islands, 1982-83.

Date	Total	Remarks
1982		
Sept 14	2	1/4 mile SE, moving W
15	4	
16	6	2 seem 18 mile N 2 seen 1-1/2 miles NE 2 seen 1 mile SE (2 of these later seen breaching 2 miles SE)
17	2	
19	1	Breaching
22	5	
23	2	
24	2	
25	1	
28	1	
30	8	
Oct 1	1	
2	1	
3	3	
6	1	
1983		
May 29	2	3 miles N, breaching and waving pectoral flippers
July 2	2+	4-5 miles SW, breaching and rolling
19	2	
20	4	1 seen 1 miles N, moving WNW, breaching 2 seen 1-1/2 miles SW 1 seen 6 miles SW, breaching
23	1	1 mile NNE
24	1	3/4 mile E
25	1	1 mile N
27	5	5 seen 3 miles NE in morning (2 seen 2 miles NE in afternoon, probably same)
28	2	2 miles NW
Aug 6	1	2 miles NW
7	2	2 miles NW
9	2	1/4 mile from island, moving N; 1 full size, 1 half size
10	9	6 seen 2 miles SSE, moving E 3 seen 2 miles SW, moving W
11	6	2 seen 1 mile SE moving W, 1 large, 1 calf size 4 seen 3-4 miles SE
13	3	3-4 miles SW
15	3	1 mile WSW, moving SE
17	2	3 miles SW
22	10	Visible all day 2-5 miles SW to SE, much breaching, flipper and fluke waving
23	1	5 miles SE
30	7	5 miles SW; 5 seen initially, 2 later seen breaching

Table 3. Sightings of blue whales from South Farallon Islands, 1982-83.

Date	Total	Remarks
1982		
Sept 11	3	4-6 miles NE, moving S
17	2	
20	2	
Oct 27	2	4-5 miles from island
30	2	
1983		
July 25	1 (probable)	3/4 miles W
Aug 9	1	1 mile SW, moving N
10	1	1/2 mile E, moving E (50-60' long)
21	2	6 miles SE; reported by boat

Table 4. Sightings of other cetaceans from South Farallon Islands, 1982-83.

Date	Total	Remarks
1982		
Sept 15	1	(possible Minke)
Oct 24	1	killer whale (probable)
1983		
June 4	15	Dall porpoise--seen between Middle and North Farallones riding bow waves during special boat trip to North islands
25	3	Harbor porpoise--seen at W end of shipping channel
July 30	2	Finback whales--100 meters ENE

There were sightings of 25 unidentified whales between 3 Sept 1982 and 19 Aug 1983.

Table 5. Weekly censuses of northern (Steller) sea lions on South Farallon Islands, 1982-83.

	Date	Total Number	Adult Males	Subadult Males	Probable Females	Immatures		Yearlings	Pups
1982									
Sept	2	2			21	10			1
	10	40			18	15			7
	16	32		1	18	10			3
	23	39			18	15			6
	30	55			42	12			1
Oct	7	30			20	4			6
	14	50			28	8			14
	19	42			21	11			10
	28	91			50	22			19
Nov	4	29			17	10			2
	11	75			30	18			27
	19	67			37	4		3	23
	26	63			31	8			24
Dec	3	94			59	7		15	13
	9	81			30	3		2	46
	17	86			46	6			34
	24	96			61	10		25	
	31	34			24	3			7
1983									
Jan	9	64			33	7		2	22
	13	73			43	11		19	
	20	57			35	13		9	
	30	131		1	76	10		44	
Feb	5	63			35	5		23	
Mar	3	113		1	77	9		26	
	10	87			55	4		28	
	17	54			28	14		12	
	24	52		1	23	20		8	
	31	60		1	29	21		9	
Apr	7	71		2	36	23		10	
	14	46			27	10		9	
	28	47		2	23	11		11	
May	5	35	1	4	13	11		6	
	12	56	7	1	32	11		5	
	19	48	10	3	20	10		5	
	26	53	8	4	28	3	(2)	8	
June	2	141	13	12	79	11		26	
	9	77	10	5	43	5		4	
	16	61	12	3	27	13		6	1
	24	93	10	11	50		(21)		
	30	67	8	10	29	20			
July	7	104	8	11	52	33			
	15	54	7	5	34	8			
	21	39	3	4	22	10			
	28	24		1	14	9			
Aug	4	26		2	18	6			
	11	44		4	21	19			
	18	26			15	11			
	25	21			17	4			

Table 6. Reproductive success of female northern (Steller) sea lions on S.E. Farallon Island, 1973-1983.

Year	Highest number of females present	Number of pups born	Percent natality	Number of premature births	Pup deaths - other causes	Percent mortality
1973	73	9	12	3	-	33
1974	110	10	9	4	-	40
1975	98	19	19	4	5	47
1976	98	14	14	5	1	43
1977	111	27	24	11	-	41
1978	103	18	17	10	-	56
1979	96	15	15	3	3	40
1980	91	26	29	14	2	61
1981	86	17	20	11	-	64
1982	99	12	12	7	1	67
1983	79	10	13	7	2	90

Table 7. Weekly censuses of California sea lions on South Farallon Islands, 1982-83.

	Date	Total Number
1982		
Sept	2	2486
	10	2901
	16	3435
	23	2070
	30	3132
Oct	7	2471
	14	3609
	19	2304
	28	3373
Nov	4	1505
	11	2771
	19	2074
	26	1690
Dec	3	3021
	9	2189
	17	2093
	24	3228
	31	1153
1983		
Jan	9	1730
	13	1642
	20	2496
	30	3731
Feb	5	2432
Mar	3	4142
	10	2226
	17	2020
	24	1585
	31	2108
Apr	7	2362
	14	2155
	21	2188
	28	2184
May	5	2117
	12	2392
	19	2197
	26	3454
June	2	3765
	9	4868
	16	3754
	24	3529
	30	3326
July	7	3494
	15	3217
	21	3680
	28	5570
Aug	4	4588
	11	5254
	18	5035
	25	4261

Table 8. Weekly censuses of harbor seals on South Farallon Islands, 1982-83.

Date	Total Number
1982	
Sept 2	35
7	20
13	29
23	40
30	43
Oct 11	43
16	56
28	63
Nov 3	39
11	58
16	47
25	44
29	47
Dec 3	54
8	62
11	55
24	40
31	54
1983	
Jan 6	43
14	62
22	32
30	32
Feb 4	40
11	31
20	29

Date	Total Number
1983(cont)	
Mar 2	58
17	13
21	34
28	90
Apr 7	63
14	72
22	71
25	87
May 2	26
8	79
13	58
18	44
29	41
June 8	40
18	57
24	57
30	46
July 7	54
17	54
21	50
28	38
Aug 4	73
10	54
18	76
25	53

Table 9. Weekly censuses of northern elephant seals on South Farallon Islands, 1982-83.

Date	Total Number
1982	
Sept 2	83
10	102
16	132
23	156
30	390
Oct 8	404
14	435
19	527
28	494
Nov 4	516
11	497
19	529
26	370
Dec 3	266
9	391
17	208
24	300
31	351
1983	
Jan 9	390
13	458+
20	766
30	805
Feb 5	737
Mar 3	318
10	375
17	400
24	416
31	636
Apr 8	482
14	560
21	642
28	797
May 5	662
12	595
19	552
26	503
June 2	304
9	198
16	123
24	105
30	79
July 7	84
15	56
21	65
28	58
Aug 4	61
11	57
18	88
25	114

Table 10. Age classes of male elephant seals during the breeding season on South Farallon Islands, 1976-1984.

Age Class	SA2 (5 yrs)	SA3 (6-7 yrs)	SA4 (7-8 yrs)	Bull (8+ yrs)	Total # Males	% Increase over previous year
1976	10 (46%)	6 (27%)	0	6 (27%)	22	
1977	18 (50%)	15 (42%)	1 (3%)	2 (6%)	36	63%
1978	26 (54%)	16 (33%)	4 (8%)	2 (4%)	48	33%
1979	34 (47%)	19 (26%)	13 (18%)	6 (8%)	72	50%
1980	32 (34%)	39 (41%)	13 (14%)	11 (12%)	95	32%
1981	62 (47%)	33 (25%)	21 (16%)	15 (11%)	131	38%
1982	66 (40%)	38 (23%)	35 (21%)	24 (15%)	163	24%
1983	89 (46%)	44 (23%)	37 (19%)	24 (12%)	194	19%
1984	68 (33%)	61 (30%)	32 (16%)	44 (21%)	205	5%

Table 11. A summary of animals involved in elephant seal breeding seasons on the South Farallon Islands, 1972-1984.

Year	Number of bulls*	Number of breeding males	Number of females present	Number of pups born	Percent increase	Pups weaned
1972	0	1	2	1		1
1973	0	1	3	2	100%	2
1974	7	1	19	17	750	5
1975	8	3	37	35	105	28
1976	6	5	62	62	71	56
1977	2	10	111	104	73	84
1978	2	18	143	133	30	99
1979	6	25	194+	184+	38	128
1980	11	22	236+	232+	26	136
1981	15	22	300+	292+	26	172
1982	24	33	375+	367+	26	255
1983	24	36	487+	475+	29	325
1984	44	38	479	447	-06	301

* as defined in Table 10.

Table 12. Number of elephant seals tagged on South Farallon Islands, 1972-1984.

Year	Adult Male	SA4	SA3	SA2	SA1	Adult Female	Imm.	Pups	Total Number Tagged
1972								1	1
1973								2	2
1974			1					5	6
1975	2		7	5		11		28	53
1976			2	3		16		56	77
1977			7	21	10	49	11	83	181
1978		2	13	22	20	62	34	98	251
1979		1	4	28	7	31	5	54	130
1980	1	8	21	33	28	51	5	137	284
1981	3	10	21	62	17	55	10	172	350
1982	2	6	16	39	10	45	6	248	372
1983	15	19	29	81	4	102	3	302	555
1984	14	20	23	69	4	91	2	301	524
									2786

Table 13. Breeding chronology for elephant seals on South Farallon Islands, 1972-1984.

Year	Bulls		Cows		Pupping
	Arrival	Departure	Arrival	Departure	
1972	6 Feb	16 Feb	20 Jan	12 Feb	20 Jan
1973	13 Jan	16 Feb	13-14 Jan	10-12 Feb	17-19 Jan
1974	27 Nov-18 Jan	28 Jan-23 Mar	2-28 Jan	9 Feb-16 Mar	15 Jan-6 Feb
1975	26 Nov-17 Jan	13 Feb-15 Mar	25 Dec-4 Feb	27 Jan-11 Mar	31 Dec-10 Feb
1976	1-22 Dec	24 Feb-11 Mar	20 Dec-4 Feb	21 Jan-7 Mar	28 Dec-10 Feb
1977	19-27 Dec	10-13 Mar	20 Dec-17 Feb	18 Jan-14 Mar	25 Dec-18 Feb
1978	6-23 Dec	10-21 Mar	19 Dec-12 Feb	18 Jan-13 Mar	23 Dec-15 Feb
1979	26 Nov-4 Jan	28 Feb-25 Mar	14 Dec-13 Feb	20 Jan-17 Mar	20 Dec-17 Feb
1980	25 Nov-1 Jan	25 Feb-24 Mar	18 Dec-20 Feb	22 Jan-26 Mar	27 Dec-26 Feb
1981	16 Nov-22 Dec	13 Feb-25 Mar	18 Dec-17 Feb	17 Jan-19 Mar	24 Dec-18 Feb
1982	15 Nov-30 Dec	17 Feb-23 Mar	20 Dec-22 Feb	16 Jan-18 Mar	24 Dec-24 Feb
1983	8 Nov-4 Jan	23 Feb-27 Mar	18 Dec-14 Feb	17 Jan-12 Mar	21 Dec-18 Feb
1984	23 Nov-19 Jan	14 Feb- 3 Apr	13 Dec-17 Feb	17 Jan-12 Mar	22 Dec-21 Feb

Table 14. Known-age elephant seal cows pupping on South Farallon Islands, 1975-1983.

Year	3 yr old	4 yr old	5 yr old	6 yr old	7 yr old	8 yr old	9 yr old	10 yr old	11 yr old	12 yr old	13 yr old	Average age
1975	1	4	1									4.0
1976	0	6	2	1								4.4
1977	3	5	4	2	1							4.5
1978	6	7	4	5	1							4.5
1979	12	8	7	4	3	1	1					4.6
1980	4	23	10	3	3	3	0	1				4.8
1981	8	11	22	10	5	1	2	0	1			5.2
1982	*0	31	16	21	10	5	1	1	0	1		5.5
1983	0	*10	24	13	21	13	4	1	1	0	1	6.3

* Because of permit complications, few pups were tagged in 1979.

Table 15. Known-age Farallon-born cows pupping on South Farallon Islands, 1978-1984.

Year	3 yr old	4 yr old	5 yr old	6 yr old	7 yr old	8 yr old	9 yr old	10 yr old	Average age
1978	1								
1979	0	2	1						4.3
1980	0	2	4	1					4.8
1981	1	4	2	3	1				4.9
1982	*0	7	5	3	2	1			5.1
1983	0	6	5	3	3	3	1		5.7
1984	0	6	4	3	2	3	1	1	5.9

* Because of permit complications, few pups were tagged in 1979.

Table 16. Island of birth for tagged elephant seals on South Farallon Islands, 1983.

	Farallones	Ano Nuevo	San Miguel	San Nicolas	Tot
No. of females	22	47	27	4	10
No. of males	9	8	21	4	4
	31	55	48	8	14
	22%	38%	34%	6%	

Table 17. Elephant seal pup mortality to weaning 1974-1984 on South Farallon Islands.

Year	Number of pups born	Number of pups died	Percent mortality	Causes of Death						
				Crushed by male	Abandoned, bitten	Drowned	Fell off cliff	Stillborn	Other	Unknown
1974	17	12	71	0	8	2	0	1	1	0
1975	35	7	20	2	0	3	1	1	1	0
1976	60	4	7	1	1	1	0	1	0	0
1977	104	20	19	5	7	6	0	2	0	0
1978	133	34	26	7	7	0	3	1	2	5
1979	184	56	30	10	14	5	8	1	1	17
1980	232	96	41	20	11	21	18	1	1	24
1981	292	120	42	16	11	21	17	2	1	42
1982	367	112	31	17	7	17	11	2	0	58
1983	475	150	32	25	11	30	10	3	-	71
1984	448	147	33	26	15	47	14	6	0	39

Table 18. A comparison of pup mortality to weaning in selected areas on South Farallon Islands, 1983 and 1984.

	S.E. FARALLON					WEST END			
	MB	SF	NL	MTSF	GG	MV	IHB	SB	Total
# pups born 1983	21	178	6	19	2	10	58	167	461
1983 % mortality	54%	33%	100%	11%	100%	90%	35%	31%	37%
# pups born 1984	24	127	32	6	22	9	58	159	437
1984 % mortality	78%	23%	72%	17%	82%	22%	31%	17%	31%

Table 19. Breeding success of male elephant seals on S.E. Farallon Island, 1984.

Specimen Number	Age	Copulations Observed	% of Total Copulations	Period of Copulation
1490	B	102	25	Jan 10 - Mar 4
968	B	55	13	Jan 30 - Mar 2
2001	B	36	9	Jan 19 - Feb 2
1845	SA4	21	5	Jan 17 - Feb 19
64	B	20	5	Feb 6 - Feb 18
1442	SA3	17	4	Jan 30 - Feb 29
574	B	16	4	Feb 9 - Mar 5
955	B	13	3	Feb 1 - Feb 23
707	B	11	3	Feb 2 - Feb 26
2002	SA3	11	3	Feb 5 - Feb 17
461	SA3	10	2	Jan 25 - Feb 11
679	B	9	2	Feb 3 - Feb 26
2003	SA3	9	2	Feb 6 - Feb 19
2004	SA4	7	2	Feb 9 - Feb 18
2005	SA3	7	2	Jan 28 - Feb 15
1833	B	7	2	Feb 1 - Feb 21
921	SA3	7	2	Feb 17 - Feb 28
928	SA3	7	2	Feb 19 - Feb 28
1186	SA4	6	1	Feb 15 - Feb 23
2006	SA2	6	1	Feb 13 - Feb 15
2007	SA4	5	1	Jan 20 - Feb 20
1897	SA4	5	1	Feb 14 - Feb 18
1190	SA4	4	<1	Feb 26 - Feb 27
1894	SA4	2	<1	Feb 1 - Feb 18
1888	SA4	2	<1	Jan 31 - Feb 4
2008	SA3	2	<1	Feb 26
2009	SA3	2	<1	Feb 26
1506	SA3	2	<1	Feb 26
2010	SA3	2	<1	Jan 31 - Feb 6
2011	B	2	<1	Feb 3 - Feb 4
2012	SA2	1	<1	Feb 26
2013	SA2	1	<1	Feb 25
2014	SA2	1	<1	Feb 19
1926	SA3	1	<1	Feb 18
2015	SA3	1	<1	Feb 7
2016	B	1	<1	Feb 11
922	SA4	1	<1	Feb 12
1910	SA3	1	<1	Feb 14
		414		

Table 20. Breeding success of male elephant seals on S.E. Farallon Island, 1983.

Specimen Number	Age	Copulations Observed	% of Total Copulations	Period of Copulations
64	B	95	21	1 Feb - 8 Mar
662	B	84	19	14 Jan - 2 Mar
1490	B	43	10	28 Jan - 25 Feb
707	B	34	08	28 Jan - 20 Feb
948	B	27	06	6 Feb - 2 Mar
663	B	22	05	24 Jan - 23 Feb
1833	B	19	04	6 Feb - 23 Feb
1852	SA3	19	04	8 Feb - 22 Feb
968	SA4	13	03	10 Feb - 10 Feb
51	B	9	02	6 Feb - 1 Mar
671	SA4	6	01	6 Feb - 25 Feb
1926	SA2	6	01	1 Feb - 11 Feb
574	B	5	01	7 Feb - 27 Feb
1845	SA3	5	01	9 Feb - 16 Feb
1257	SA3	5	01	5 Feb - 21 Feb
1186	SA3	5	01	18 Feb - 23 Feb
679	SA4	4	<1	17 Feb - 1 Mar
1859	SA3	4	<1	14 Feb - 1 Mar
1442	SA2	4	<1	1 Feb - 6 Feb
1870	SA4	4	<1	12 Feb - 16 Feb
1504	SA4	4	<1	12 Feb - 20 Feb
1846	SA3	3	<1	3 Feb - 11 Feb
1910	SA2	3	<1	1 Feb - 2 Feb
1491	SA3	3	<1	29 Jan - 8 Feb
1858	SA3	3	<1	10 Feb - 22 Feb
561	SA3	3	<1	11 Feb - 20 Feb
933	B	2	<1	7 Feb - 12 Feb
955	SA4	2	<1	10 Feb
1841	SA2	2	<1	14 Feb
1894	SA3	2	<1	10 Feb
1873	SA4	2	<1	12 Feb
693	SA4	1	<1	1 Mar
1461	SA3	1	<1	11 Feb
1457	SA2	1	<1	7 Feb
1506	SA2	1	<1	6 Feb
127	SA4	1	<1	5 Mar
		447		

Table 21. Weaner mortality in northern elephant seals on South Farallon Islands, 1976-1983.

Year	Number dead			Dates of deaths
	M	F	Total	
1976		1	1	15 Mar
1977	2	1	3	14 Feb - 15 Mar
1978	1		1	6 Mar
1979			0	
1980	2	1	3	19 Feb - 9 Apr
1981	1		1	9 Mar
1982	4	5	9	2 Mar - 21 Apr
1983	11	19	30	24 Jan - 8 Apr

Table 22. Resightings of elephant seals tagged as pups on South Farallon Islands, 1974-1982.

YEAR	1974				1975				1976				1977				1978			
Number of pups born	17				35				60				104				133			
	F	M	Total	%	F	M	Total	%	F	M	Total	%	F	M	Total	%	F	M	Total	%
Pups surviving to weaning (first spring)	2	3	5	29	18	10	28	80	27	29	56	93	35	49	84	81	50	49	99	74
first fall	1	2	3	18	9	5	14	40	14	11	25	42	21	22	43	41	23	24	47	35
second spring	1	2	3	18	9	4	13	37	10	11	21	35	20	19	39	38	19	20	39	29
second fall	1	2	3	18	8	4	12	34	8	10	18	30	16	16	32	31	16	12	28	21
third spring	1	2	3	18	7	4	11	31	6	7	13	22	13	15	28	27	12	11	23	18
third fall	1	2	3	18	7	4	11	31	6	6	12	20	10	9	19	18	12	11	23	18
fourth spring	1	2	3	18	7	4	11	31	6	5	11	18	8	7	15	14	11	8	9	14
fourth fall	1	2	3	18	4	4	8	23	5	5	10	17	6	5	11	11	8	8	16	12
fifth spring	1	2	3	18	4	2	6	17	5	3	8	13	6	4	10	10	7	4	11	8
fifth winter	1	2	3	18	4	1	5	14	4	2	6	10	6	3	9	9	5	4	9	7
sixth winter	1	2	3	18	3	1	4	11	4	1	5	8	5	3	8	8	4	3	7	5
seventh winter	1	2	3	18	3	1	4	11	3	1	4	7	3	1	4	4				
eighth winter	1	2	3	18	3	1	4	11	3	0	3	5								
ninth winter	1	2	3	18	1	0	1	3												
tenth winter	1	0	1	06																

Table 22. Resightings (cont'd)

YEAR	1979				1980				1981				1982				TOTAL YEARS	
Number of pups born	184+				232+				292+				367+				1424+	
	F	M	Total	%	F	M	Total	%	F	M	Total	%	F	M	Total	%	Total	%
Pups surviving to weaning (first spring)			128	70	65	68	137*	59	76	83	172*	59			255	69	964	68
first fall	15	18	33	(39)**	26	27	54*	23	37	34	75*	26	50	51	106*	28	318	30
second spring	13	12	25	(29)	20	23	44*	19	26	19	49*	17	35	37	77*	21	246	23
second fall	10	9	19	(24)	17	15	33*	15	24	17	44*	16	20	22	46*	13		
third spring	9	9	18	(23)	16	14	31*	14	23	13	38*	13						
third fall	8	8	16	(18)	14	8	22	10	15	7	22	08						
fourth spring	8	8	16	(18)	13	7	17	8										
fifth winter	8	5	13	(15)	9	5	14	7										
sixth winter	4	3	7	(10)														

* Total includes animals of unknown sex.
** Because of permit complications in 1979, only 46% (59/128) of pups surviving to weaning were tagged. All percentages have been adjusted accordingly.

Table 23. Tag loss in elephant seals double-tagged as pups on South Farallons

	With One Tag	With Two Tags	Rate of Tag Loss
Observed Second Spring	7	126	7/133 = .053
Observed Third Spring	10	54	10/64 = .156
Observed Fourth Spring	3	21	3/24 = .126

Table 24. Survival rates of elephant seals tagged as pups on South Farallons corrected for tag loss.

	Minimum Survival	Corrected for Tag Loss
Second Spring (1975-82)	250/1223 = 20%	263.5/1223 = 22%
Third Spring (1975-81)	137/856 = 16%	183.4/856 = 21%
Fourth Spring (1975-80)	77/564 = 14%	140/564 = 24%

Table 25. Squid beaks found in stomachs of elephant seals on South Farallons 1983-1984.

Age/Sex	Date of Death	Stomach Contents	
Adult female	5 Feb. 1983	Octopoteuthis deletron	1 upper
			1 lower
		Histioteuthis heteropsis	2 lower
Adult female	26 Feb. 1983	Octopoteuthis deletron	9 upper
			9 lower
		Gonatus sp.	1 lower
Immature male	6 Apr. 1983	Octopoteuthis deletron	32 upper
			32 lower
		Histioteuthis heteropsis	1 upper
			2 lower
		Dosidicus sigas	1 upper
			1 lower
		Vampyroteuthis infernalis	1 upper
			1 lower
		Mastigoteuthis pyrodes	1 upper
			1 lower
		Gonatus sp.	5 upper
			5 lower
		Lironeca sp.	
		Unidentified fish teeth	
Immature male	13 Mar. 1983	Onychoteuthis borealjaponicus	1 upper
			1 lower
Subadult male	28 Jan. 1984	Octopoteuthis deletron	37 upper
			25 lower
		Histioteuthis heteropsis	3 lower
		Mastigoteuthis pyrodes	1 lower
		Gonatus sp.	1 upper
			1 lower
		Unidentified squid beaks	

N
California sea lion
Steller sea lion
Harbor seal
Northern elephant seal
Northern fur seal
Fisherman's Bay
North Landing
Aulon Peninsula
Shubrick Point
Sea Lion Cove
Light house
Shell Beach
WEST END
Breaker Cove
SOUTHEAST FARALLON
marine Terrace
MARINE Terrace
GARBAGE Gulch
Sea Pigeon Gulch
Mirounga Beach
Sand Flat
Mussel Flat
Pastel Cove
Indian Head
SEAL ROCK

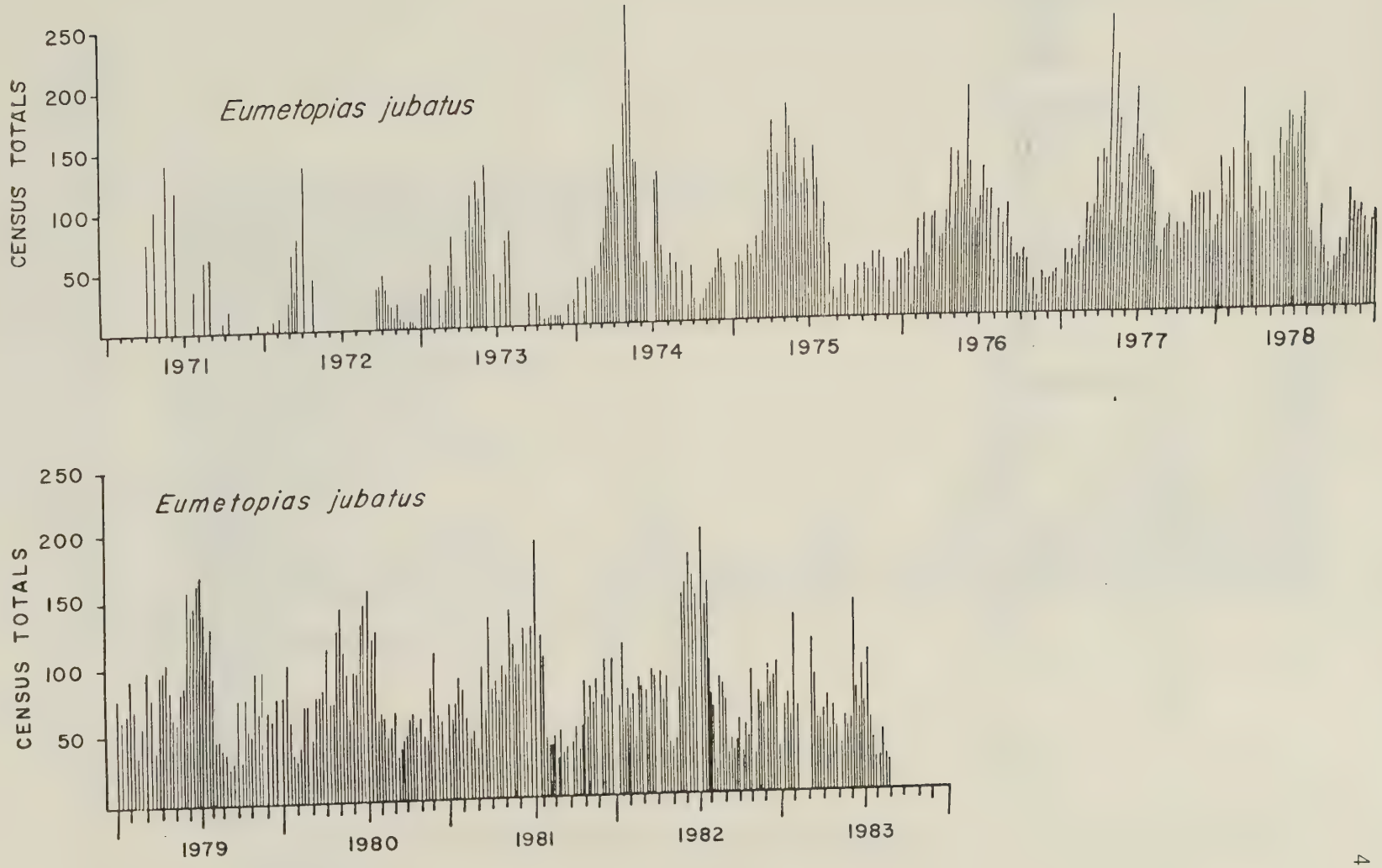


Figure 2. The occurrence of northern (Steller) sea lions (Eumetopias jubatus) at the Farallones, 1971-1983.

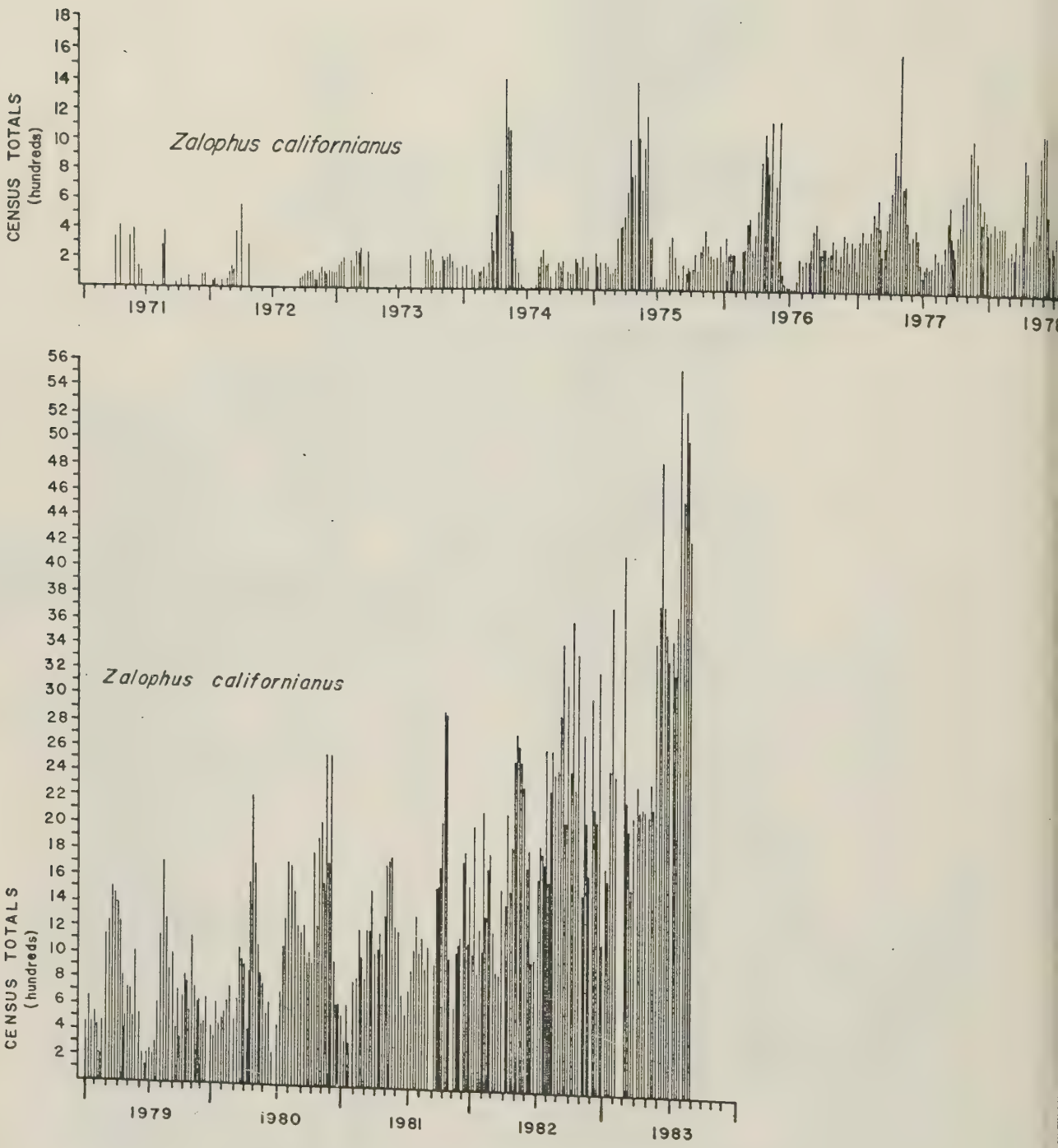


Figure 3. The occurrence of California sea lions (Zalophus californianus) at the Farallones, 1971-1983.

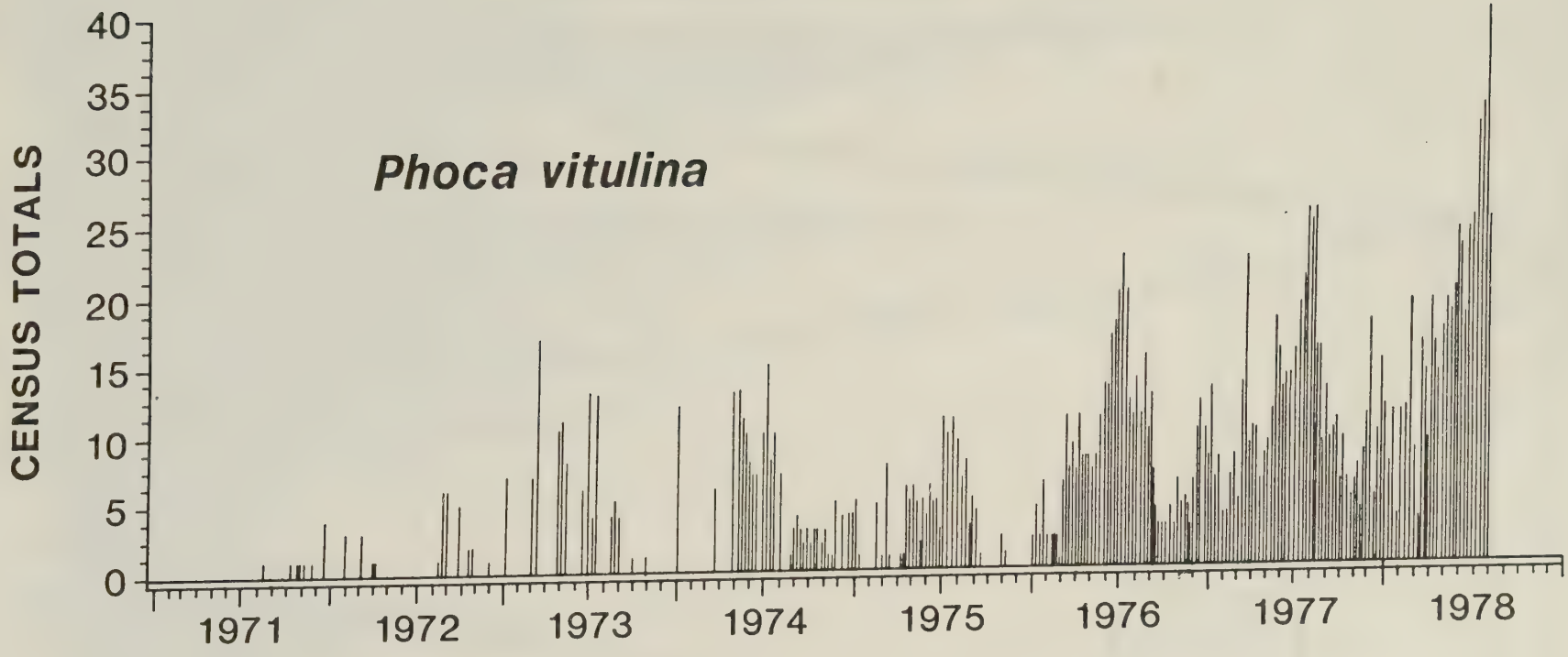


Figure 4a. The occurrence of harbor seals (Phoca vitulina) at the Farallones, 1971-1978.

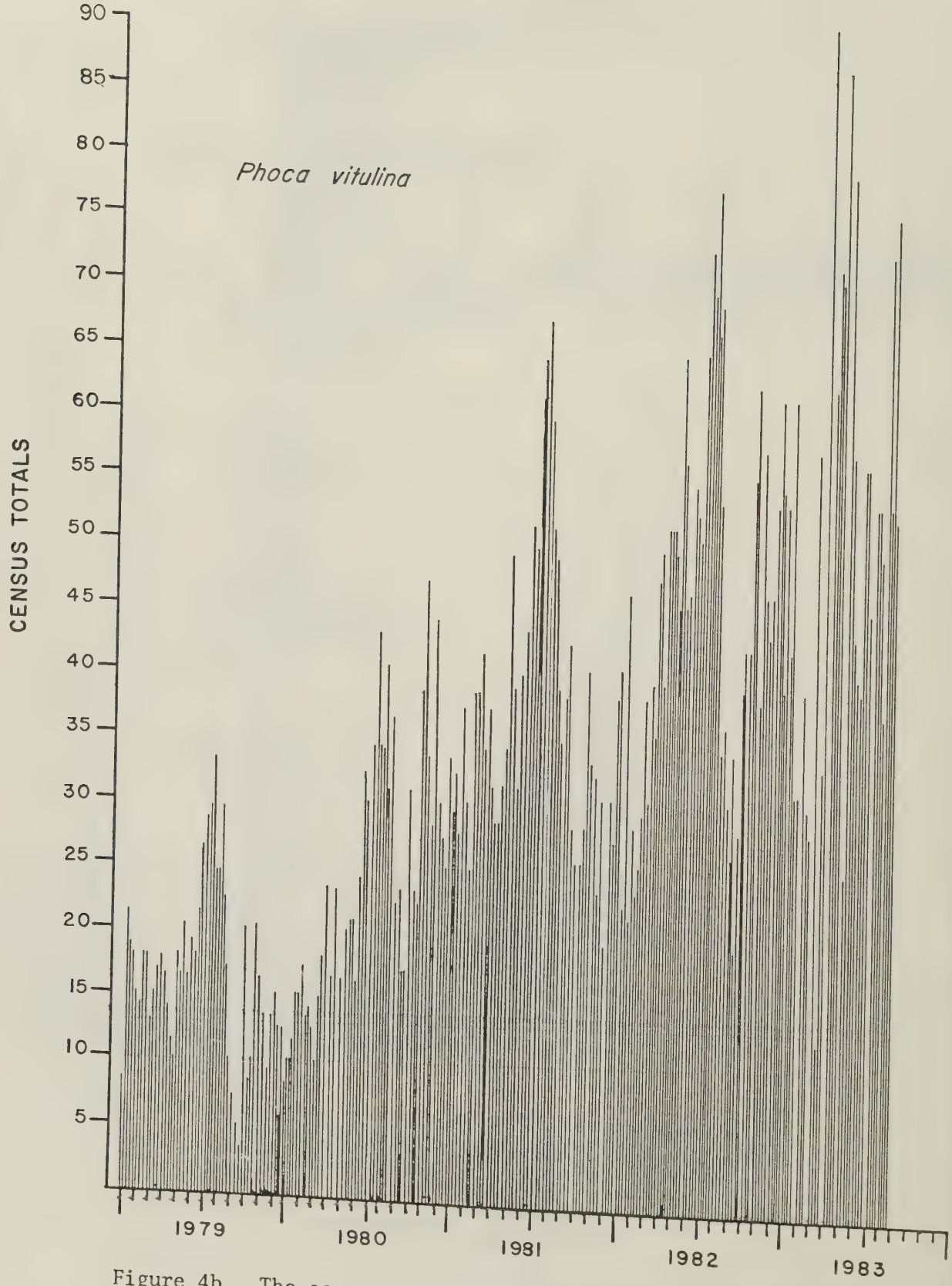
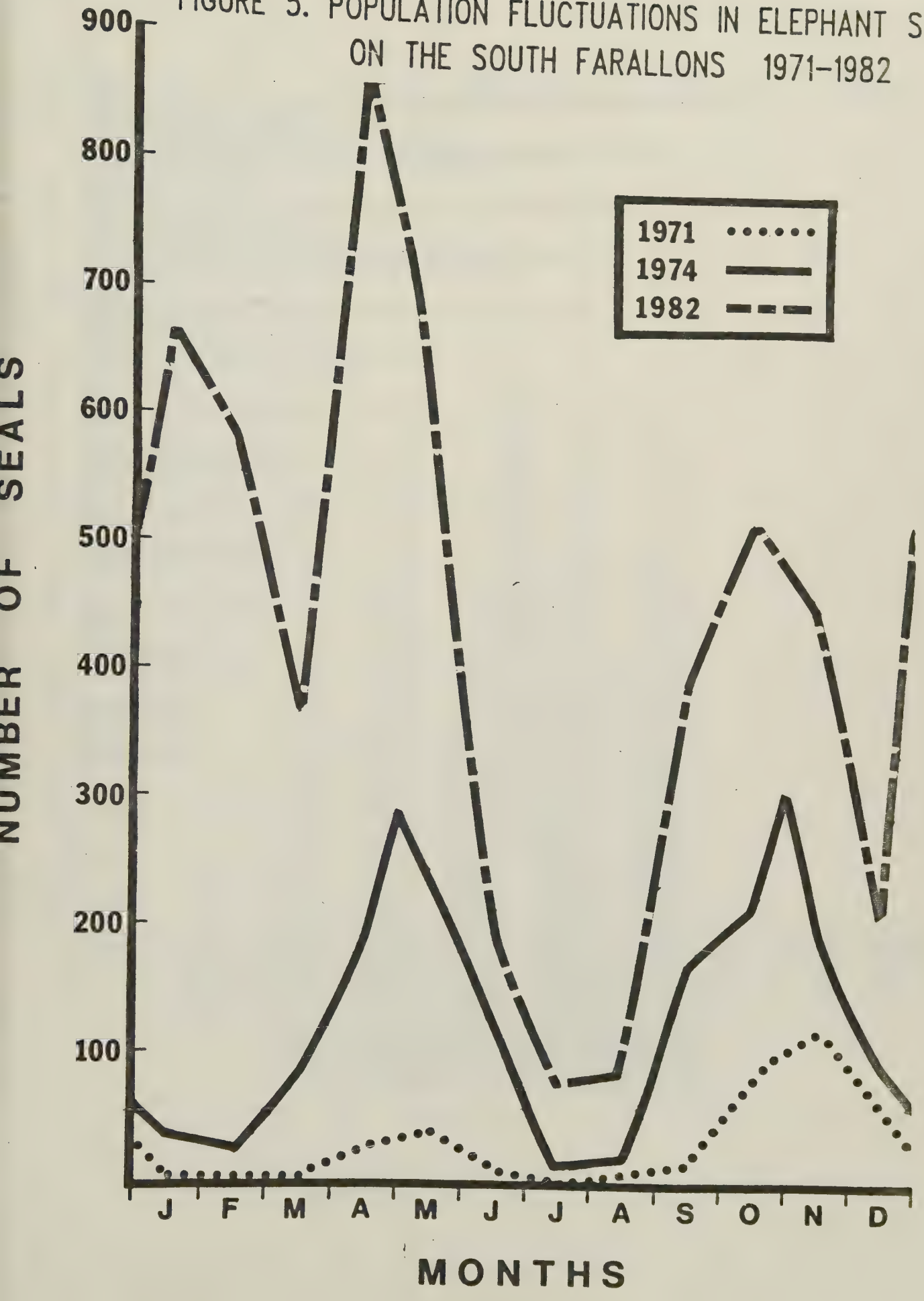


Figure 4b. The occurrence of harbor seals (Phoca vitulina) at the Farallones, 1979-1983.

FIGURE 5. POPULATION FLUCTUATIONS IN ELEPHANT SEALS ON THE SOUTH FARALLONS 1971–1982



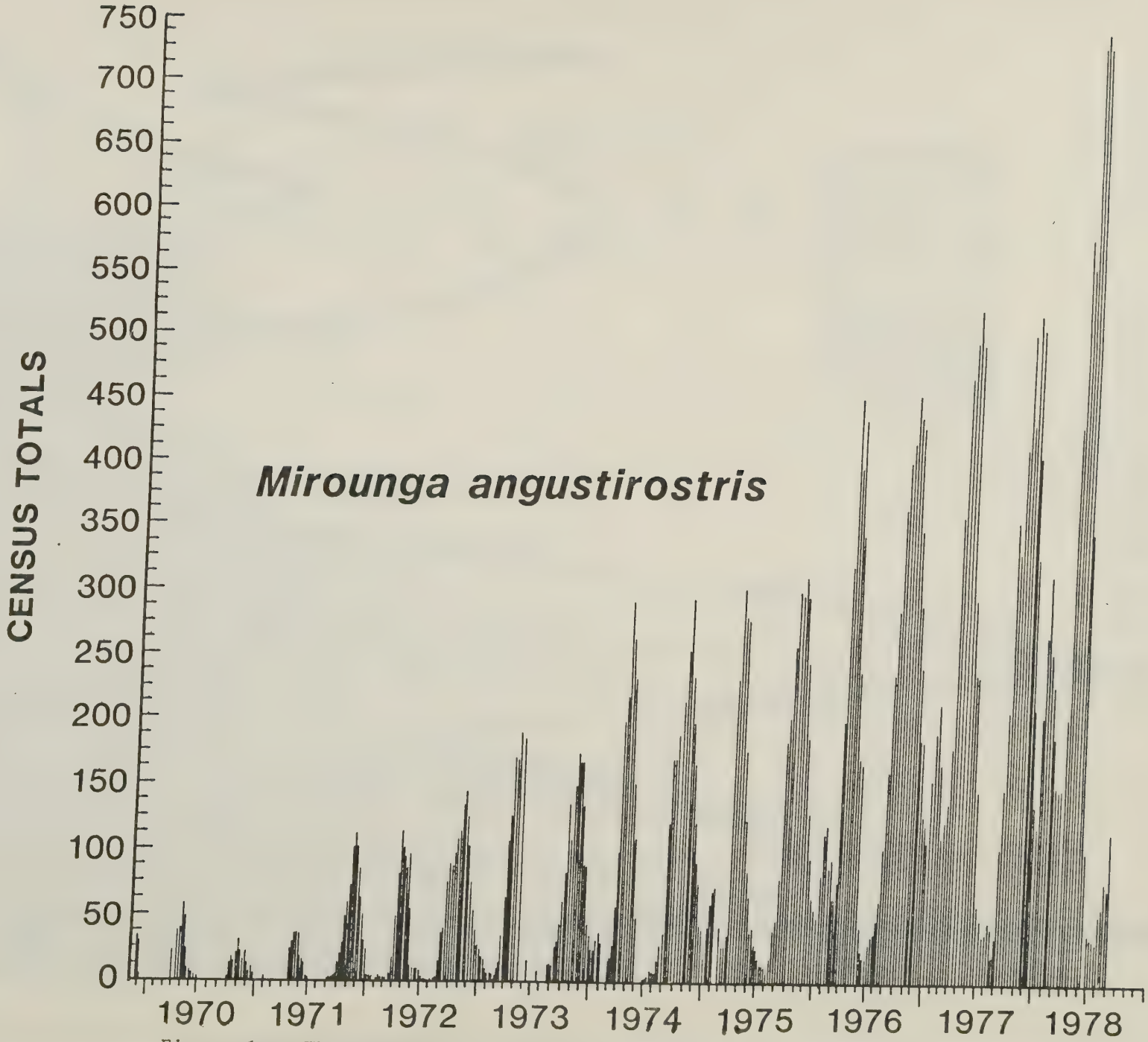


Figure 6a. The occurrence of northern elephant seals (Mirounga-

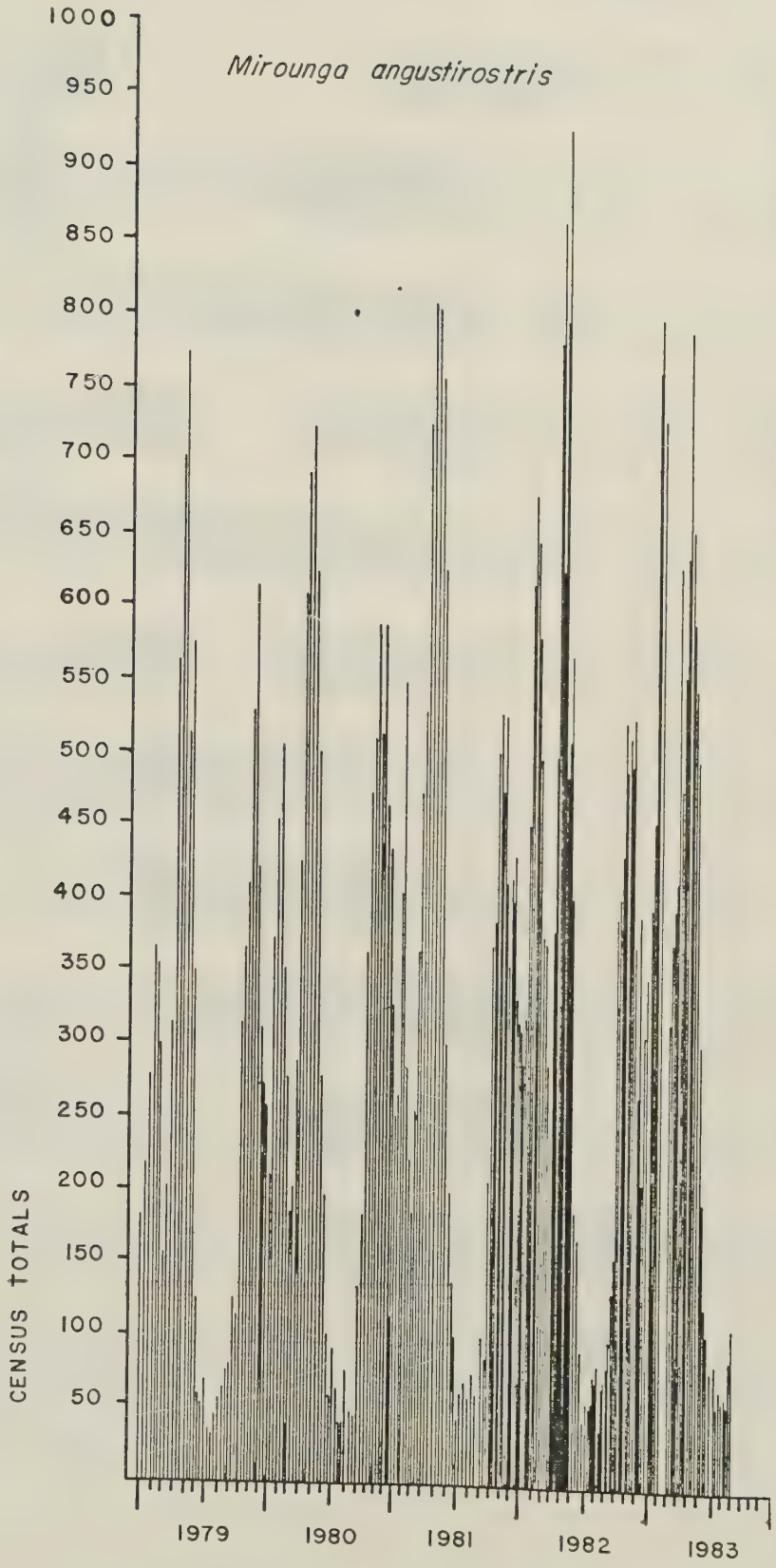


Figure 6b. The occurrence of northern elephant seals (Mirounga angustirostris) at the Farallones, 1979-1983.

FIGURE 7. AGE COMPOSITION OF MALES SAND FLAT, 1984

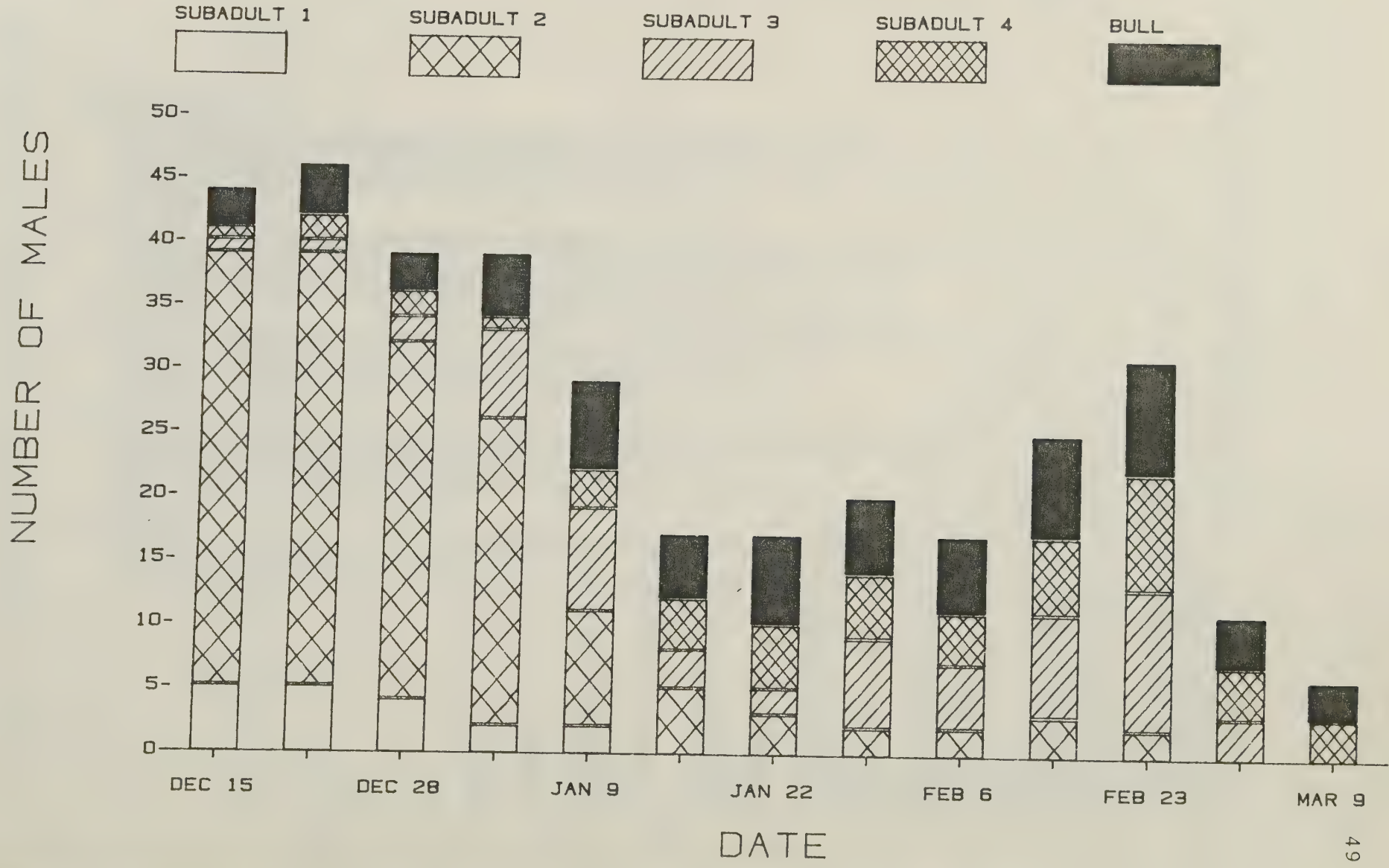


FIGURE 8. AGE COMPOSITION OF MALES SOUTH FARALLON ISLANDS, 1984

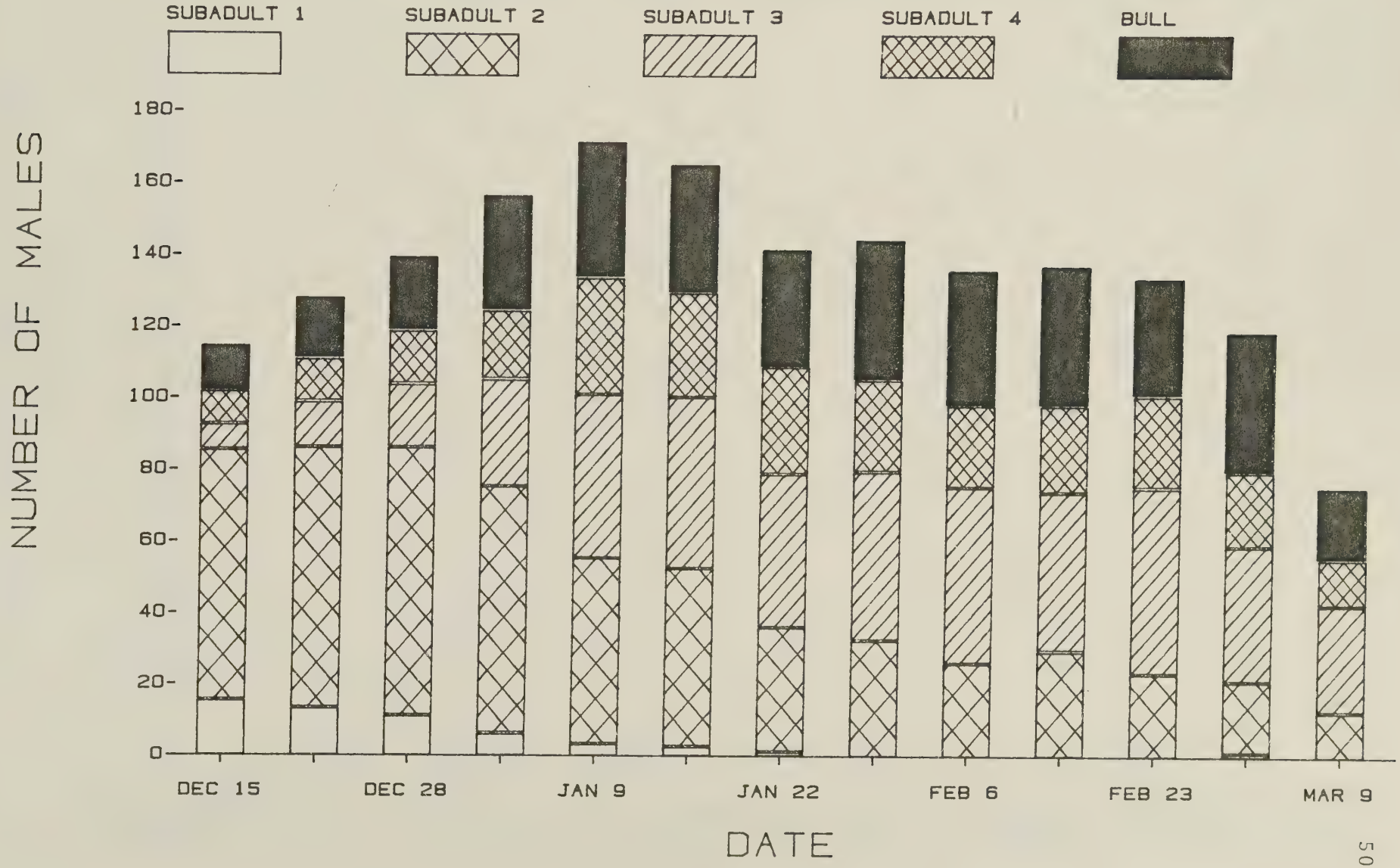


FIGURE 9. FEMALE ELEPHANT SEALS ON SAND FLAT 1983--1984 BREEDING SEASONS

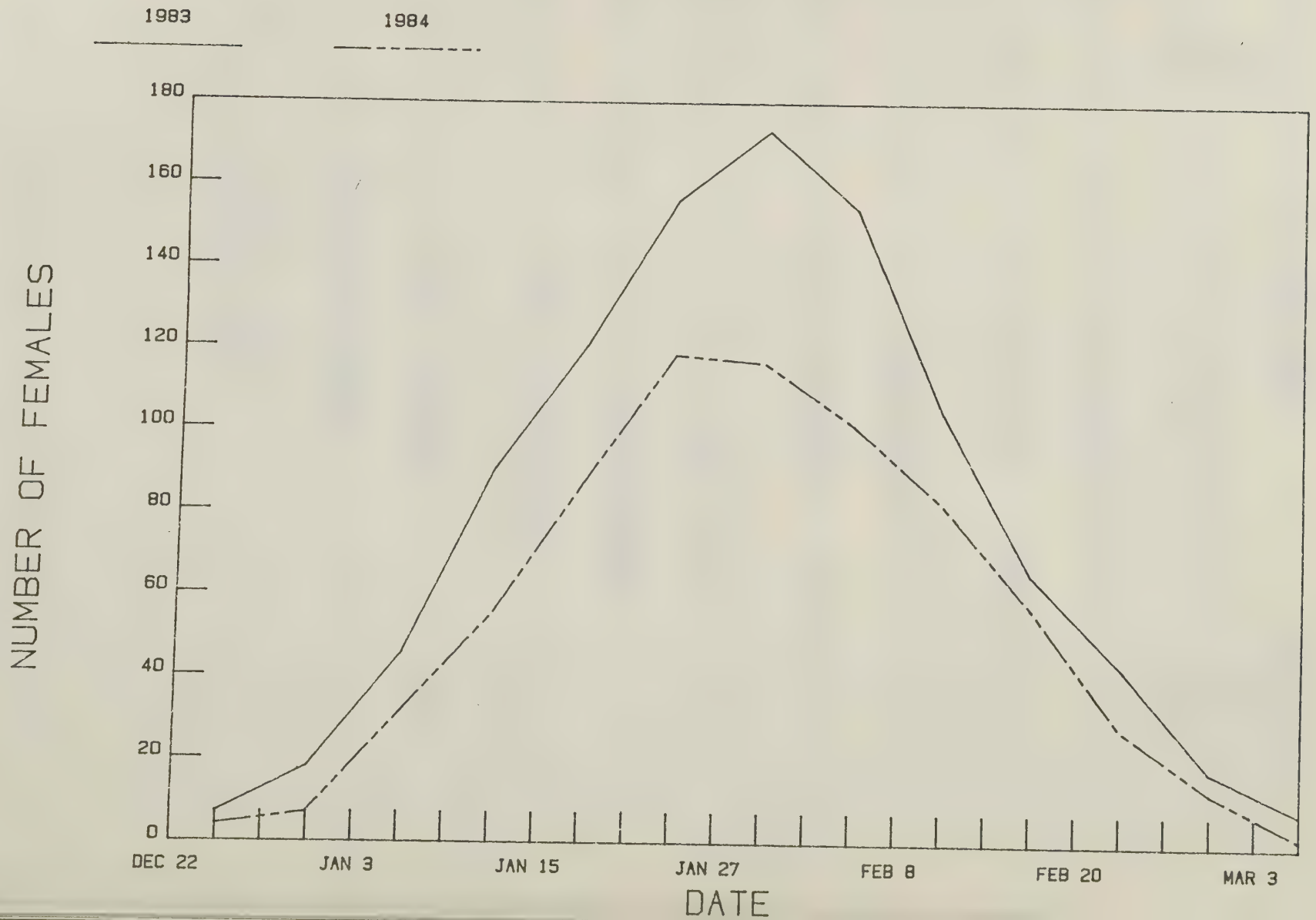


FIGURE 10. FEMALE ELEPHANT SEALS ON SHELL BEACH 1983--1984 BREEDING SEASONS

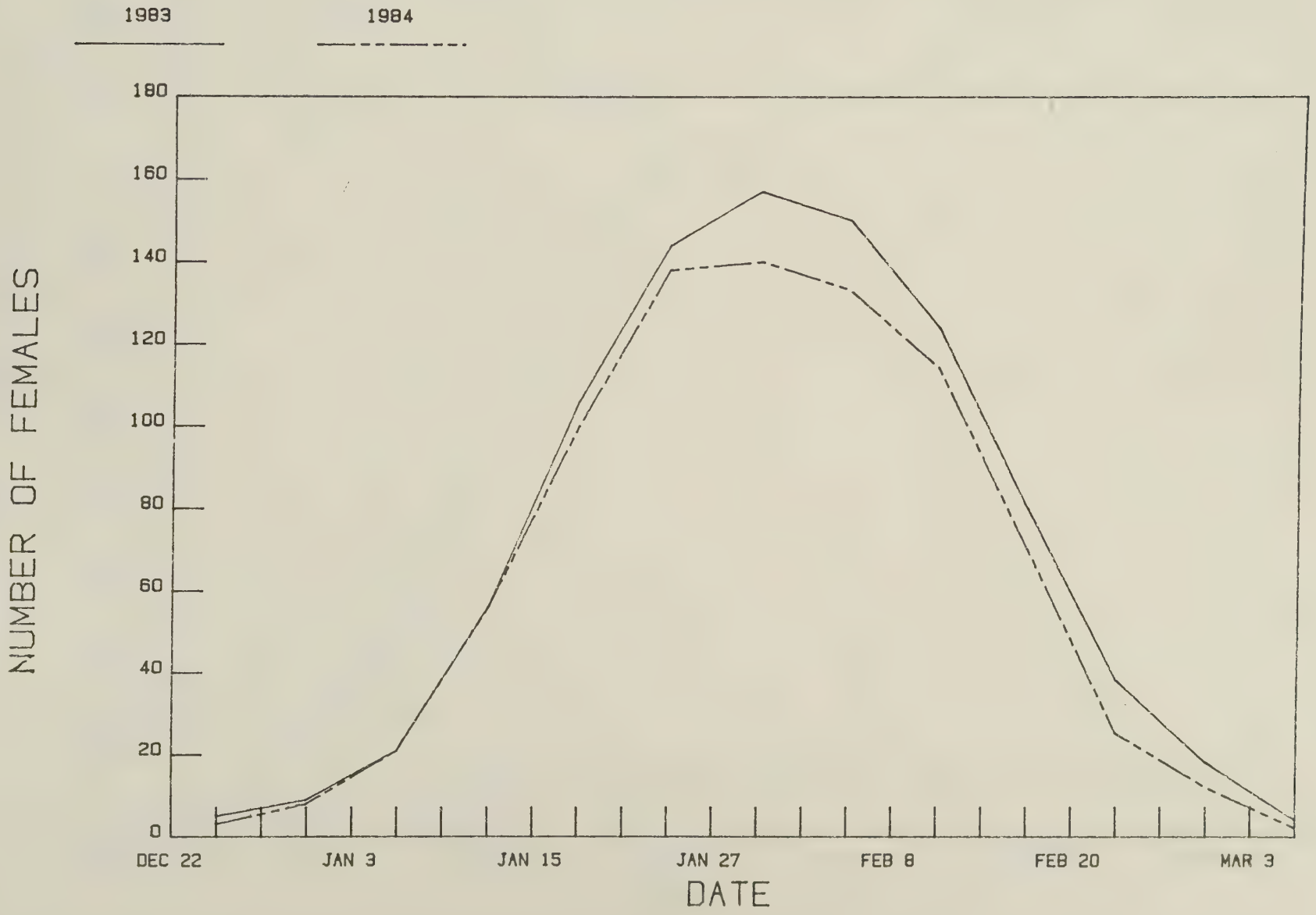


FIGURE 11. FEMALE ELEPHANT SEALS ON INDIANHEAD 1983--1984 BREEDING SEASONS

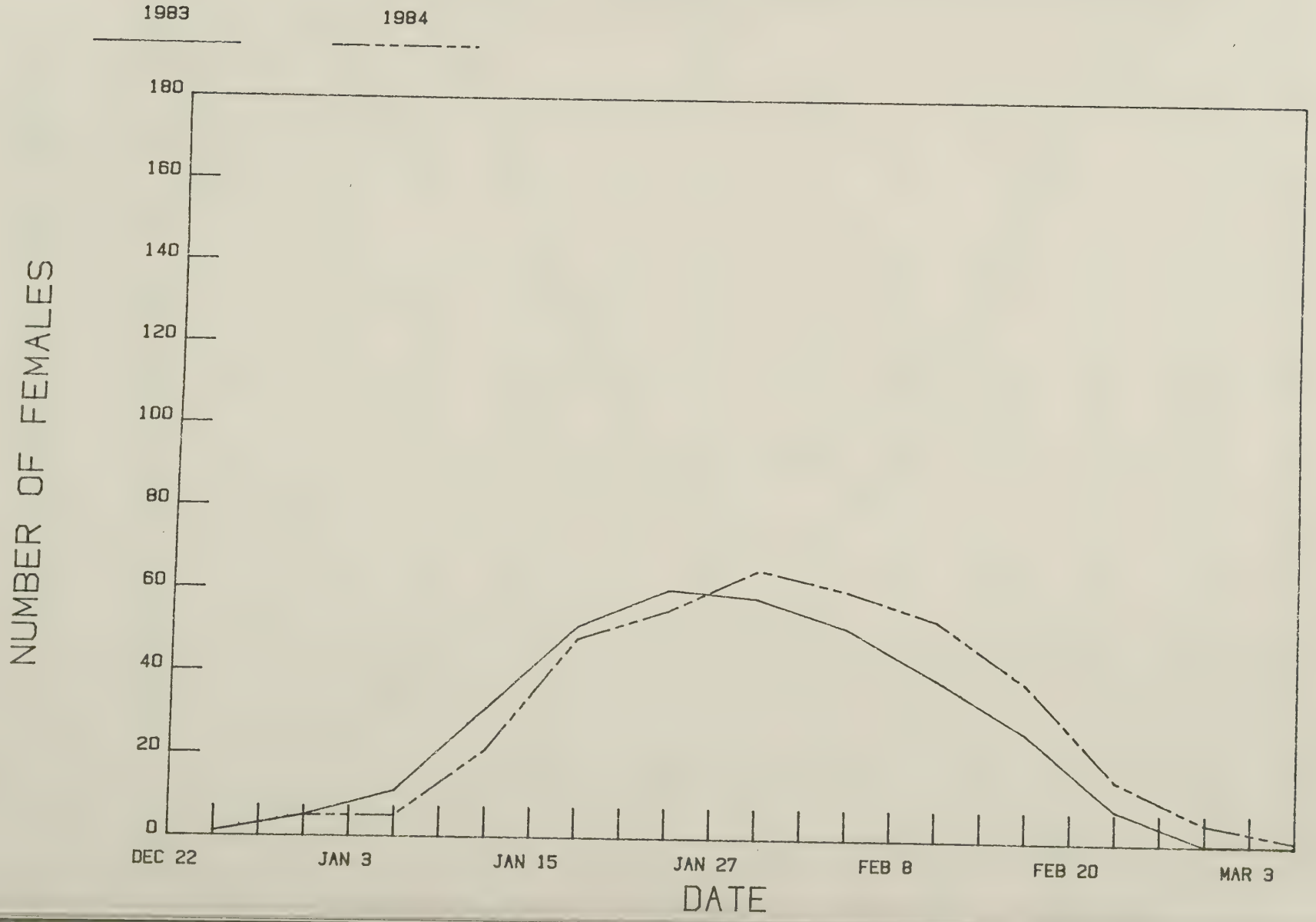


FIGURE 12.

FEMALE ELEPHANT SEALS ON SOUTH FARALLONS
1983 -- 1984 BREEDING SEASONS

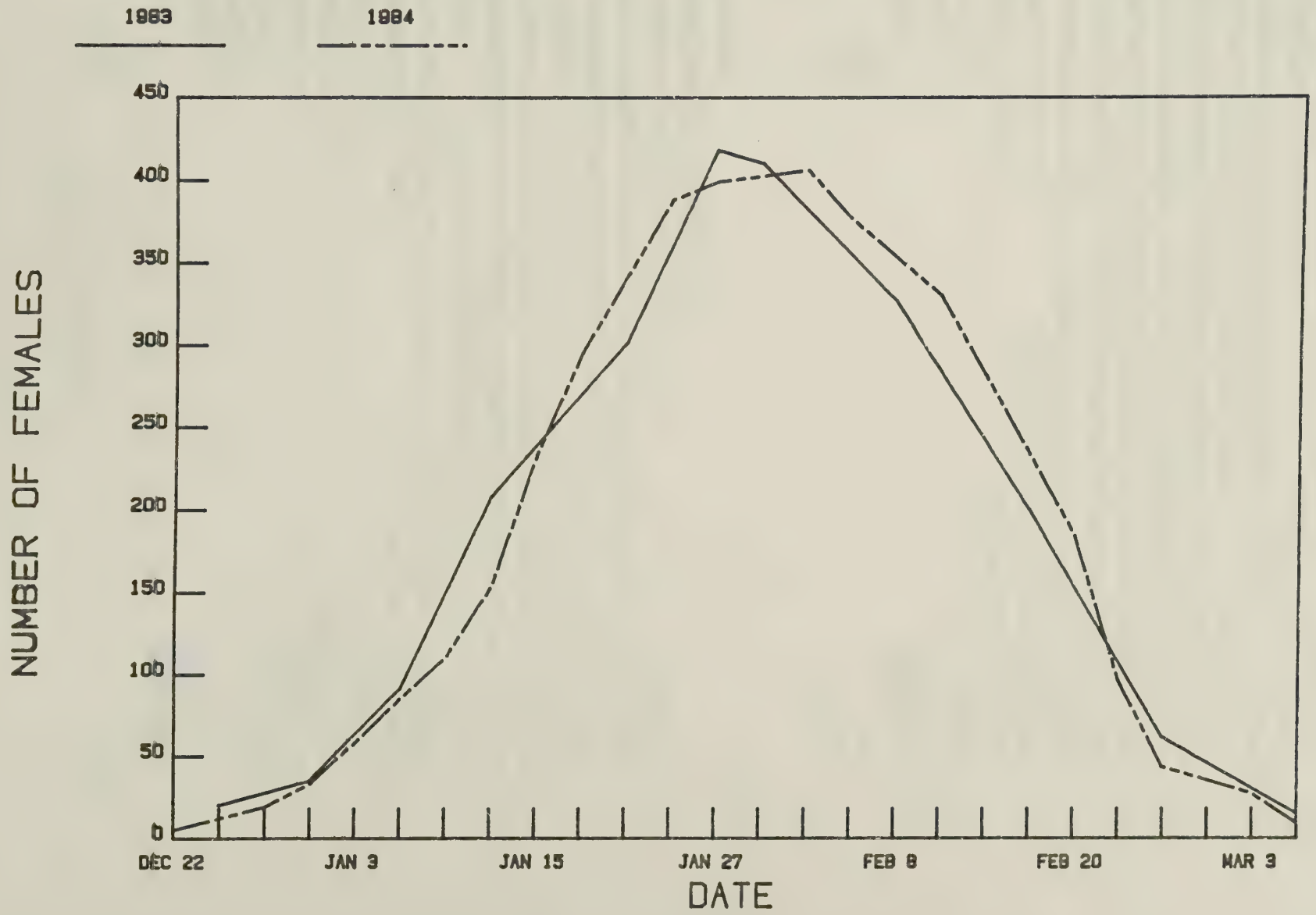
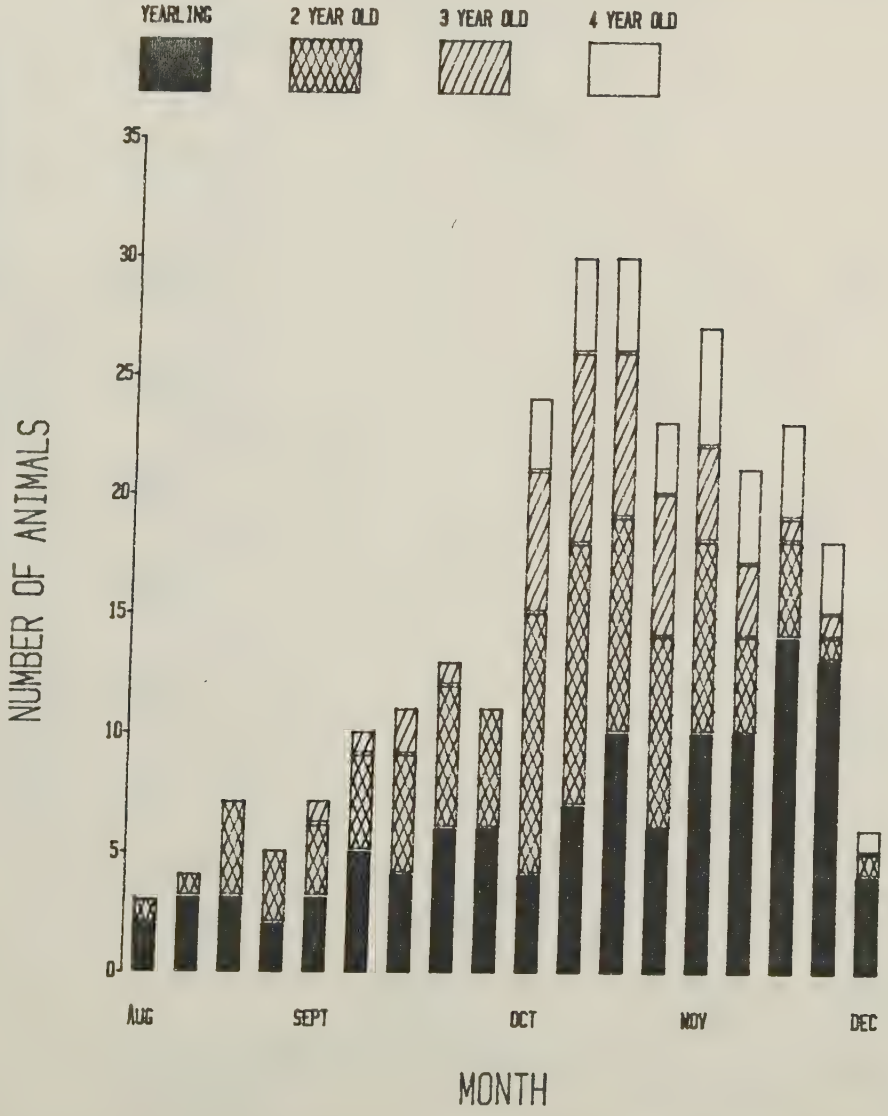


FIGURE 13. IMMATURE FARALLON-BORN ELEPHANT SEALS BY AGE FALL 1982



IMMATURE FARALLON-BORN ELEPHANT SEALS BY AGE FALL 1983

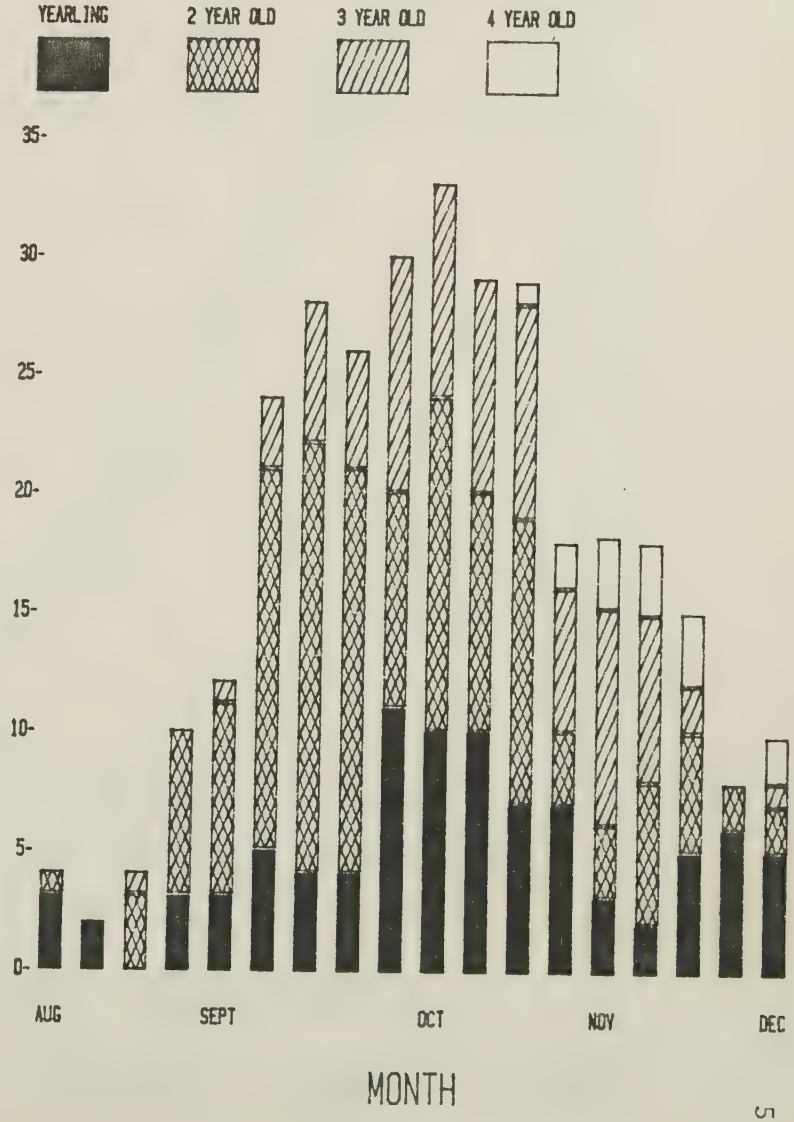
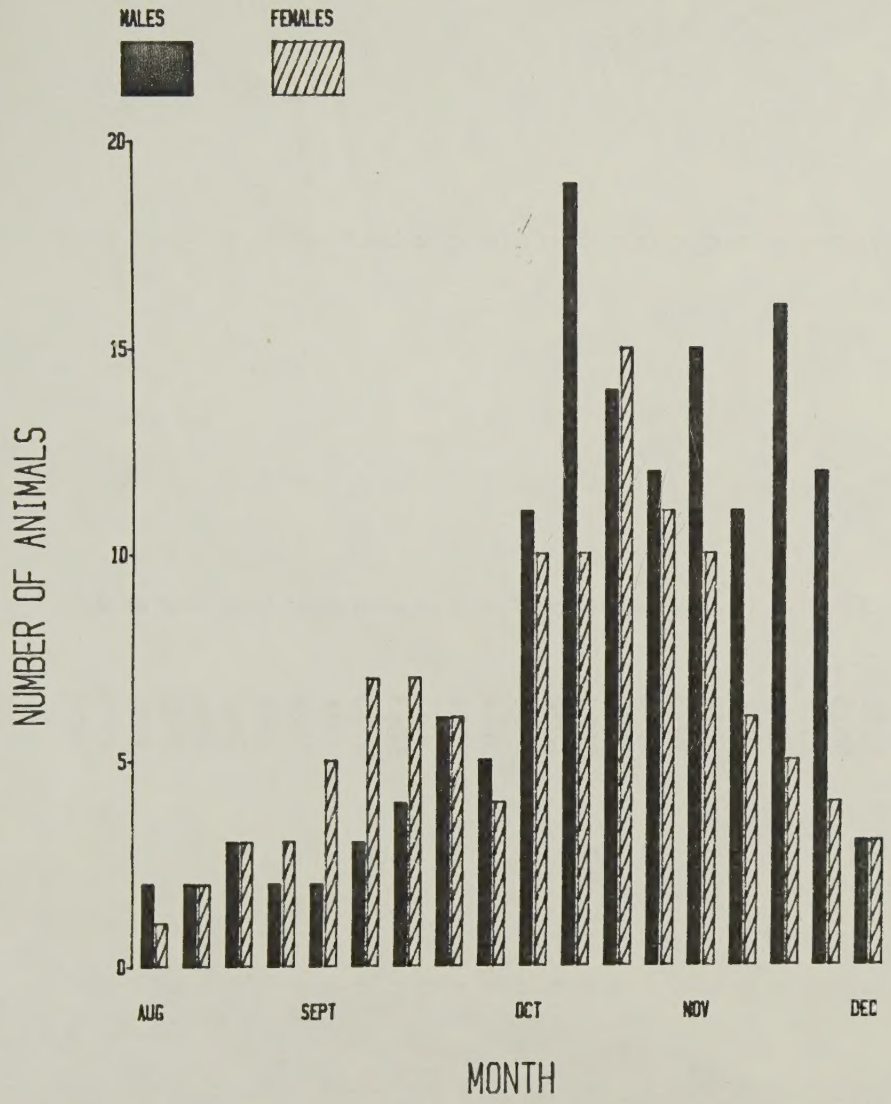
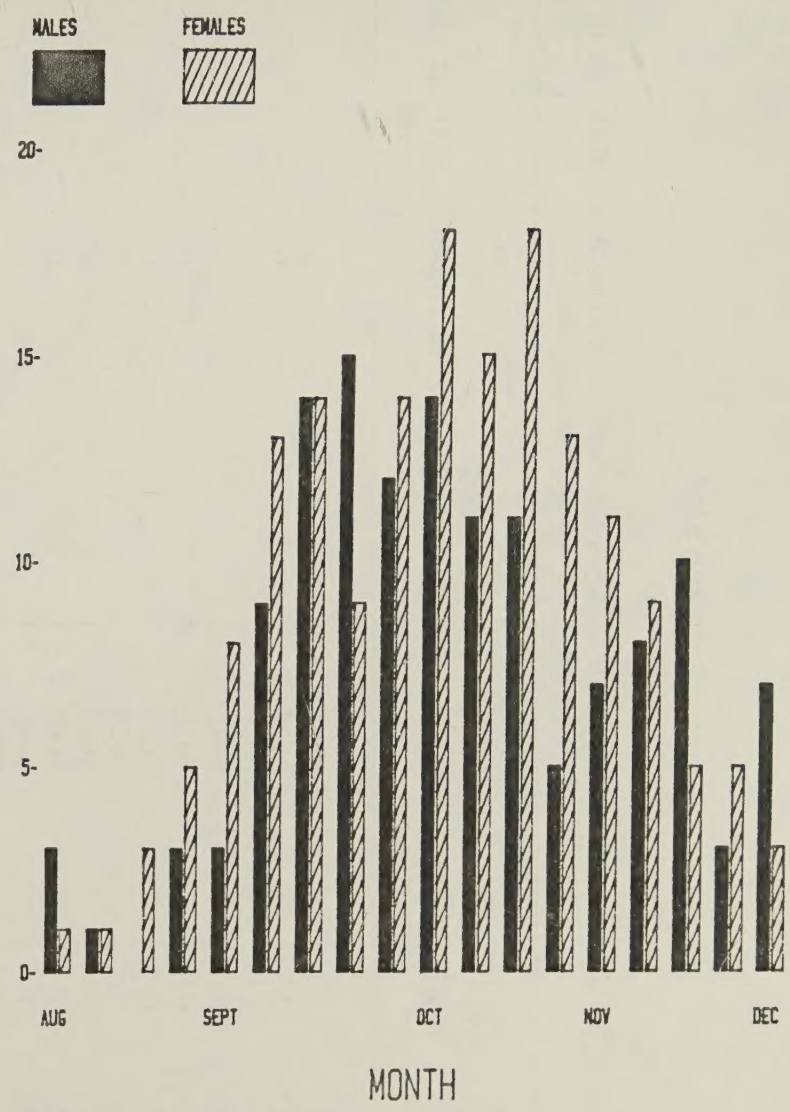


FIGURE 14. IMMATURE FARALLON-BORN ELEPHANT SEALS BY SEX FALL 1982



IMMATURE FARALLON-BORN ELEPHANT SEALS BY SEX FALL 1983



APPENDIX

ZALOPHUS TAGGED BY THE MARINE MAMMAL REHABILITATION CENTER RESIGHTED ON THE FARALLONES SEPTEMBER 1982 TO SEPTEMBER 1983

DATE OBSERVED	FIRST TAG COLOR	FIRST TAG PREFIX	FIRST TAG NUMBER	FIRST TAG FLIPPER	SECOND TAG COLOR	SECOND TAG PREFIX	SECOND TAG NUMBER	SECOND TAG FLIPPER	LOCATION
83 04 25	B		0	R					MF
83 06 27	B	L	0009	R			0		GG
83 07 15	B	L	0009	R			0		GG
83 04 05	B	L	0061	R					SLC
83 09 22	O		5052	R			0		GG
83 09 29	O		5052	R			0		GG
83 08 28	O		5053	L			0		EL
83 09 23	O		5059	?			0		GG
83 09 07	O		5065	L			0		NL
83 09 27	O		5065	L			0		GG
83 09 28	O		5065	L			0		GG
83 09 27	O		5069	R			0		GG
83 09 01	O		5073	L			0		NL
83 09 22	O		5073	L			0		SLC
83 09 22	O		5073	L			*** ANIMAL DEAD***		
83 08 15	O		5074	L			0		NL
83 08 31	O		5075	L			0		GG
83 09 12	O		5075	L			0		GG
83 09 15	O		5075	L			0		GG
83 09 17	O		5075	L			0		GG
83 09 29	O		5076	L			0		GG
83 09 05	O		5078	R			0		GG
83 09 16	O		5078	L			0		GG
83 09 23	O		5078	L			0		GG
83 08 30	O		5080	R			0		GG
83 09 02	O		5080	R			0		GG
83 09 05	O		5080	R			0		GG
83 09 13	O		5080	R			0		GG
83 08 22	O		5081	L			0		GG
83 09 17	O		5084	L			0		GG
83 09 22	O		5084	L			0		GG
83 09 18	O		5085	L			0		NL
83 09 19	O		5085	L			0		NL
83 09 14	O		5086	R			0		NL
83 09 15	O		5086	R	B	L	0036	L	NL
83 09 18	O		5086	R	B	L	0036	L	NL
83 09 21	O		5086	R			0		NL
83 09 28	O		5086	R			0		NL
83 09 29	O		5086	R			0		NL
83 09 29	O		5086	R	B	L	0036	L	NL
83 09 27	O		6908	R			0		GG
83 08 27	O		7078	L			0		GG